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WATSONIA

Journal and Proceedings of the Botanical Society of the British Isles

[illegible] 1977

Volume 11 Part 3 January, 1977
Editors: G. Halliday, N. K. B. Robson, C. A. Stace

ISSN 0083-1603

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

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Watsonia, **11**, 189–194 (1977).

Presidential Address 1976

NORFOLK AND BOTANY

E. L. SWANN

Today there falls to me both the privilege and the pleasure as a mere amateur to give you the Presidential Address. Since I joined this Society 37 years ago I have witnessed a five fold increase in membership with an enormous growth in technical skill and professional competence. Our publications have brought us a well-deserved reputation and today we have attained international status as was clearly shown at the Cambridge Conference (1974) when more than 20 visitors and speakers came from continental Europe. Among the many disciplines, bewildering at times, frightening by their complexity, an amateur has to pick his way very carefully. Thinking about this Address I decided there was only one subject on which I could perhaps claim some familiarity and that was my own county of Norfolk in which I have botanised for some fifty years.

When I attend meetings of this Society at Burlington House I see the walls of the Linnean Society adorned with pictures of famous botanists, several of whom were born in Norfolk. But for one, there would probably have never been a Linnean Society, certainly no Linnean collections in London. I refer, of course, to Sir James Edward Smith; others are Sir William Joseph Hooker, Director of Kew Gardens for 24 years, and John Lindley, the father of orchidology, secretary to the Royal Horticultural Society for nearly 40 years and the man mainly responsible for saving Kew Gardens for the nation.

If you will bear with me for a time I should like to try and find a reason, some explanation for the outstanding reputation of early Norfolk botanists and why they were leaders of scientific thought in the eighteenth and nineteenth centuries. It may be a flight of fancy but I believe the answer is sheep. It was during the reign of Edward III (1327–1377) that Flemish weavers were persuaded to set up their looms in and around Norwich. The abundance of local supplies of wool laid the foundation of the staple industry and Norwich became the second city of the realm. According to repute, the Flemings and the Walloons introduced many new or little-known plants such as the lilac, Provence rose, asparagus, carrot, celery and cabbage. Their gardens were walled-in enclosures but it is surely not difficult to picture them bringing in other plants from the country around Norwich when they were conscripted each year to help with the harvest; nor is it surprising that the taste for gardening spread to the local inhabitants and with it the study of wild flowers. Proof of this view comes from Ray's *Flora of Cambridgeshire*, recently translated (1975) by Mr A. H. Ewen and Dr C. T. Prime:

'Among we English the people of Norwich excel in their enthusiasm for the cultivation of beautiful flowers: they celebrate each year with a Festival of Flowers and award a prize of a floral wreath for the most neatly arranged flowers. For this reason they boast that Norwich should be called either a town in a garden or a garden in a town.'

It is to Sir Thomas Browne, the famous physician, mathematician, theologian and alchemist – an intellectual giant if ever there was one – that we owe two of our earliest plant records. He spent the last 45 years of his life in Norwich and in 1668 sent a box of the Sweet Flag (*Acorus calamus*) to one of his London friends. This plant, by reason of its aromatic leaves, was used for strewing on the floors of churches to counteract the somewhat less pleasant smells of the crowds of worshippers. Large quantities were sent to London and here must be the first awakening of conservation because the raiding of local supplies aroused the anger of the natives. Sir Thomas also recorded the Sea Holly (*Eryngium maritimum*) from Great Yarmouth in the same year, writing that 'Ringstones, a small black and white bird like a wagtayle . . . common about Yarmouth sands. They lay their egges on the sand and shingle about June, and as the *eryngo* diggers tell mee, do not set them flat, but upright like egges in salt'.

Of Benjamin Stillingfleet, R. W. Ketton Cremer (1944) in his *Norfolk Portraits* writes:

'A few people in every century are destined, whatever their real achievements and distinctions, to be remembered by posterity for some irrelevant reason. A peculiarity of manner, speech or dress, the responsibility for some popular innovation, a spectacular success or mishap—every trick of association has contributed to swell the ranks of this goodly company. This was the case with Benjamin Stillingfleet, a man of learning and cultivation who advanced the progress of knowledge and taste in a variety of modest ways, like all good botanists, but he is remembered because he wore blue stockings of worsted made from Norfolk wool in the drawing rooms of learned ladies and was the unconscious originator of an universal phrase.'

It was whilst staying with his friend Robert Marsham at Stratton Strawless that he kept careful records of natural history, which he published in 1761 as his *Calendar of Flora* and it ran to four editions. It contains no fewer than 250 early plant records.

It was Sir James Edward Smith who became the most famous of Norfolk botanists. Born in Norwich in 1759 and living until 1828, he acquired a European reputation. From his earliest years he was interested in botany; in his letters he records 'I can just remember tugging ineffectually with all my infant strength at the tough stalks of the wild succory on the chalky hillocks about Norwich'. At the age of 18 he began the study of botany as a science and the only book he could then procure was John Berkenhout's *Outlines of the Natural History of Great Britain and Ireland*, published in 1770 in three volumes. Then he was shown the works of Linnaeus and writes 'Never shall I forget the feelings of wonder excited by finding his whole system of animals, vegetables and minerals contained in three octavo volumes'. This obviously refers to one of the early editions of *Systema Naturae*, but it was the first edition of *Species Plantarum* (1753) which gave added impetus to his career. Although his father wanted him to join the family business of woollen and silk merchants, Smith was determined to make botany his life's work and the only way possible was to take up medicine. He went to Edinburgh because it was then the only place where medicine was combined with botany. He studied under Dr John Hope, the first teacher of the Linnean system in Scotland. Two years later, in 1783, Smith went to London to continue his medical studies and he spent many happy hours with Sir Joseph Banks; it was Banks who persuaded him to buy the collections of the great Linnaeus. Smith's father advanced the money, the total cost being £1088.5/-. So, the possessions of Linnaeus were brought to England by a Norwich man and purchased with Norwich money. In 1788 Smith and some of his friends founded the Linnean Society and Smith remained its President until his death in 1828, fourteen years after being knighted. When he died, the Linnean collections were still at his house in Norwich. It had been hoped that the President would bequeath them to the Society, but this was not to be. After long deliberations they were sold to the Society for 3,000 guineas, and as a result the Linnean Society was very short of funds for years afterwards.

Smith's help was sought in many ways and he did not always get the credit he deserved. In 1790 Sowerby asked him to help in publishing coloured plates of British plants and Smith wrote:

'I readily undertook the letter-press of this work, and it came out in monthly numbers, under the title of *British Botany*. . . . The flippancy with which everybody quotes "Sowerby" whom they know merely as the delineator of these plants, without adverting to the information of the work or the name of the author, leads me to the mortifying conclusion that all I have done is of little avail, except to the penetrating eye of the scientific few, who stand less in need of such assistance. But with their approbation I am conscious I ought to be content.'

Smith had the gift of encouraging others from all walks of life to take up botany: Dawson Turner, banker, who became an authority on algae; John Pitchford, surgeon and apothecary, whose favourite genera were *Carex* and *Mentha* (like most of the Norwich school of botanists he contributed to *English Botany* and it was he who discovered *Holosteum umbellatum* and *Peucedanum palustre*) and James Crowe, landowner of Lakenham near Norwich, who was closely associated with Smith for many years. Together they paid particular attention to the willows, many of which were grown in Crowe's large garden. The foundation for the classification of this puzzling genus was laid by Smith, and salicologists following him were very unwilling to differ from one who had devoted so much time to their study. Unfortunately, he did not believe in the existence of hybrids, writing 'seedlings innumerable, springing up all over the ground, were never destroyed till their species were determined, and the immutability of each verified by our joint inspection. This was the more

material, to set aside the gratuitous supposition of the mixture of species, or the production of new, or hybrid ones, of which, no more than of any changes in established species, I have never met with an instance'.

Smith's influence extended over many years and as late as 1926, in the Botanical Exchange Club Report of that year, James Fraser stated 'In many cases today, Smith's species remain where he left them at the beginning of the nineteenth century except that the "×" denotes that they are hybrids and not species'. It must be one of life's ironies that Smith's name should be commemorated by one of our most frequent hybrids, *Salix* × *smithiana*, the cross between *S. cinerea* and *S. viminalis*.

Other names come to mind such as Lilly Wigg, in turn shoemaker, schoolmaster and bank clerk (his was the first record for *Trifolium suffocatum* in the British Isles), and the Rev. Charles Sutton, for whom the Linnean Society published the monograph on the genus *Orobanche* in 1789. Another clergyman was the Rev. Joseph Forby, who was also interested in willows, and Smith acknowledged his indebtedness to him by describing one of Forby's discoveries as *Salix forbyana*, the Fine Basket Osier. What would Smith have said were he to be told that this willow seems likely to be a ternary hybrid, a cross between *S. cinerea*, *S. purpurea* and *S. viminalis*!

The most famous of the Norwich school was undoubtedly Sir William Joseph Hooker, who was born in Norwich, and it was from Smith that he received the bias which determined his career, ultimately becoming Director of Kew Gardens and the author of some 50 volumes of descriptive botany. These are but a few, a very few, of the many Norfolk botanists and it cannot be denied that we have a very rich heritage.

What of the county itself? It is a self-contained unit for there is but one place where you may enter without having to cross a river bridge, and that is at South Lopham where the River Waveney rises on one side of a small road and the Little Ouse on the other. The series of ecologically important habitats provide a rich flora ranging from the shingle ridges, sand-dunes and salt-marshes bordering its 87 miles of coastline, to the Broads, and to that part of Breckland to be found in south-west Norfolk. There are also sandy heaths and commons, semi-natural woodland, calcareous valley fens (for chalk is the backbone of the county), bogs, a few remaining chalk downs, rivers, dykes and ponds.

But man has so dominated and exploited his environment that it is almost unbelievable that the greater part of Norfolk was formerly one vast sheep-walk. The vegetation is almost all artificial and the only remaining natural habitats are the sea-coast and its bordering salt-marshes and sand-dunes. Human activities have been the greatest factor for change. Fields are no longer allowed to lie idle, arable land replaces much of our woodland and scrub, hedges are uprooted, fens drained and dykes filled in. Large areas of salt-marsh have been reclaimed whilst new roads, airfields and building operations have all taken their toll. It would appear that the lot of the present-day botanist is a sorry one.

There are still rewarding places to be found in Breckland, although much of its area is given over to dense conifer plantations. It is in this area that neolithic man came to settle and, as W. G. Clarke, the naturalist who first coined the word 'Breckland', points out in his classic *In Breckland Wilds* (2nd ed., 1937):

'The important neolithic flint mines at Grime's Graves; the flint implements scattered by the million over the surfaces of its heaths and arable fields, its extensive mileage of primitive trackways; its numerous barrows and other relics of early settlers, all indicate that in some of the prehistoric periods it was one of the most thickly populated districts in the country. These invaders of early man from the Continent initiated forest clearance of the native pine and birch and by a slow process stock-keeping by nomad hunters evolved into some primitive agriculture.'

Then followed a long period of change and decay with the displacement of the primitive people. Pollen analyses have shown that this was probably due to climatic changes and for many hundreds of years Breckland remained a vast sandy heath. The greatest numbers of Norfolk Enclosure Acts received the royal assent between the years 1799 and 1815. Land was enclosed; trees were planted, chiefly Scots pine, many of which, gnarled and deformed by 'the wind on the heath', are still to be seen. Thus Breckland has been subjected to a complete cycle of changes: first native forest, then clearance, and today we have one of the largest of modern forests created by the Forestry Commission who started their planting in 1922.

It was suggested that the lot of the present-day botanist might be thought to be a sorry one, but is this really true? We have become so accustomed to the publicity about losses in plant-life, and loud have been the laments about the effects of pollution. Maybe we have been more fortunate in Norfolk but our losses of truly native species do not exceed 5%, whilst the number of species recorded has shown a remarkable increase. To assess the changes in our flora it is necessary to have comparisons, and fortunately we have three Floras published at approximately 50 years' intervals together with four Supplements. The first *Flora of Norfolk* was published in 1866 and listed 1,030 species; it was the work of the Rev. Kirby Trimmer, who held the livings of Burnham Norton and Stanhoe in West Norfolk. The second appeared in 1913 and represented the labours of W. A. Nicholson, a bank clerk, who worked for some 30 years on this volume, which was published by the Norfolk and Norwich Naturalists' Society and contained 1,208 species. In 1968 the third Flora was published to coincide with the centenary of that Society. Aided by a keen team of contributors, and with the result of some 50 years of fieldwork, Dr C. P. Petch and the writer were able to raise the number of species to 1,563, whilst the recently published Supplement has brought our total to 1,701.

Strangely enough we lost more native species prior to 1914 than since that date. No two botanists will ever agree about what constitutes a native species; there are some who consider that any plant which arrives and establishes itself by natural means in natural or semi-natural habitats without allowance for the time factor is a native. Thus, the American Willow-herb (*Epilobium adenocaulon*) would be called native, but this is absurd. My estimate of native status is based on distribution, both within and outside our area, nature of the habitat, and historical evidence. We appear to have lost five since Nicholson's day. The Fen violet (*Viola stagnina*) was last seen in 1936; the Northern Shorewort (*Mertensia maritima*) disappeared from the shingle ridge at Blakeney in 1931; Mudwort (*Limosella aquatica*) was last seen in 1916 and the Greater Broomrape (*Orobanche rapum-genistae*) in 1920. In spite of careful searching each spring we can no longer find *Veronica verna* in the Norfolk Breckland; there is a specimen in J. E. Lousley's herbarium dated 1938 and he saw it at Santon for a few years after. Three species thought to be extinct in 1968 have recently been refound: they are the Common Clubmoss (*Lycopodium clavatum*), the Bladderwort (*Utricularia neglecta*, now to be called *U. australis*) and Field Southernwood (*Artemisia campestris*). New discoveries have been the Dutch rush (*Equisetum hyemale*), Wayfaring Tree (*Viburnum lantana*), Saw-wort (*Serratula tinctoria*) and Meadow Saffron (*Colchicum autumnale*).

The influx of aliens accounts for the greatest number of changes and in 50 years they have risen from 194 to 485. Whilst some are only casuals, others are becoming integrated into the flora. Already a few have shown an explosive increase such as the Oxford Ragwort (*Senecio squalidus*), American Willow-herb (*Epilobium adenocaulon*), Slender Speedwell (*Veronica filiformis*), and 'Gallant Soldier' (*Galinsoga parviflora*). There have been two main sources of introduction. During the Second World War our autumn botanising was considerably enlivened by the many carrot-field aliens from American seed sources under Lend-Lease arrangements. Of the 32 weeds recorded, the most frequent were species of *Amaranthus* (American Pigweed) and Cock-spur grass (*Echinochloa crus-galli*). Owing to the low winter temperatures few have persisted but, in 1976, *Amaranthus bouchonii* appeared in thousands along the peaty road verges of one of the Breck fens. The other source is the very rich rubbish-tip at Harford Bridges, near Norwich. Bird-seed aliens figure prominently and Canary Grass (*Phalaris canariensis*) now occurs on most of the tips throughout the county. Towards the end of its use as a tip, Harford was more or less dominated by *Kochia densiflora*, related to the garden 'Burning Bush'.

The four-fold increase in hybrids from a mere 26 to 109 calls for some explanation. It would be invidious to claim that we are better botanists than our predecessors; a far more likely explanation is the considerable disturbance of the habitat for, as the American botanist Edgar Anderson points out in his book *Introgressive Hybridization* (1949): 'The environment exacts a powerful control over the results of natural hybridization.' Disturbed ground may well apply to the greater part of Norfolk today. Two species hitherto occupying their own separate ecological preferences may be brought together so that they more readily hybridize and the first generation of hybrids can be expected to survive if there are zones in which conditions as a whole are somewhat intermediate between that of the previous habitats. An example of this is the cross between the Red and White Campions. It usually has pink flowers and is fertile. The Red Campion is a true native of woodland on the better soils whilst the White Campion is more strictly a naturalised alien of arable land and waste

places. The hybrid frequently occurs between woodland and arable land, for example road verges and hedgerows, an intermediate taxon occupying intermediate habitats.

As observed by Dr P. F. Yeo in *Hybridization and the flora of the British Isles* (ed. C. A. Stace (1975)), 'When any two species of *Euphrasia* alike in chromosome number occur together, hybrids are likely to be found'. *Euphrasia confusa* is the most abundant species in Norfolk, occurring on basic grassland, particularly in Breckland, chalk pits and forest rides, whilst *E. nemorosa* grows on damp soil where the vegetation is lush. On Foulden Common, a calcareous fen in West Norfolk, the hybrid is found in an intermediate zone between the chalky grassland and the fen proper. Individuals have been found to vary considerably suggesting introgressive hybridization; the 1975 *Supplement* deals more fully with this genus.

Thanks to the help and encouragement given by Dr C. E. Hubbard, another Norfolk man, the grasses have been intensively studied as will be seen both in the 1968 *Flora of Norfolk* and its 1975 *Supplement*. Many hybrids occur, some supporting Anderson's observations. In the loose sand along the foreshore there are extensive colonies of the Sand Couch (*Agropyron junceiforme*), whilst the Sea Couch (*A. pycnanthum*; *A. pungens* auct.) occurs on shingle-banks, sand-dunes and salt-marshes. The Hybrid Sea-Couch (*A.* × *obtusiusculum*) 'frequently occupies a zone in the fixed dunes intermediate between that of *A. junceiforme* on the loose sand and of *A. pycnanthum* fringing the salt-marshes' (C. E. Hubbard, *Grasses*, 2nd ed., 1968). When Couch or Twitch (*A. repens*) grows in arable land near the sea, the hybrid between this and *A. pycnanthum* is found occasionally along sea-banks.

Much as we deplore the loss or reduction in numbers of many of the Breckland specialities, there are compensations by way of new plants. There would appear to be good evidence that the dense conifer plantations have brought about an increase in humidity and along some of the tracks and in the more open woodland new plants have arrived. At Cranwich there is a flourishing colony of Creeping Lady's Tresses (*Goodyera repens*) growing in pine litter; in 1973 no fewer than 70 flowering stems were counted. In 1969, the Isle of Wight variety of the Green-flowered Helleborine (*Epipactis phyllanthes* var. *vectensis*) was discovered at Santon and in 1948 Dr A. S. Watt found a rare alien Skullcap (*Scutellaria hastifolia*) in a wood near Brandon; the colony has since increased considerably.

In addition to the land utilised by the Forestry Commission, several thousand acres are owned by the War Department. This so-called 'Battle Area' has unwittingly become a large nature reserve, for no trees are planted, public pressure of necessity is reduced to a minimum, and flocks of sheep keep the grass well grazed, for these 'four-legged grass mowers' are the best and only way to conserve chalk grassland. In 1967, a rare grass, Matgrass Fescue (*Nardurus maritimus*) was found growing in two chalk pits on Sturston Warren, and from a similar habitat in 1975 Dr C. P. Petch detected it near West Harling.

There must surely be other species awaiting discovery along the several hundreds of miles of tracks and rides in this region. Maybe, too, other species hitherto considered to be extinct will be refound like the Dutch rush (*Equisetum hyemale*). At the time of its discovery in 1974, Dr E. A. Ellis wrote a note in the *Eastern Daily Press* (16.2.1974) in which he expressed surprise that it had not been detected before, as it was so abundant for some 200 yards in a hedgerow. The reason is that, although conspicuous in winter and early spring when the associated shrubs are leafless, in summer and autumn it is completely hidden by a prolific growth of the Common Horsetail (*E. arvense*). A count of the shrubs occurring in every 30 yards' length of the hedge showed that these averaged between five and six, so that, using the Hooper system for dating hedges, the result suggested that it originated somewhere between 1200 and 1400, long before the Enclosures but coinciding with medieval expansion. The ground flora was characteristic of woodland and early maps show woodland present, the hedge being part of a boundary. In Smith's day the Dutch rush was known as the Greater Rough Horsetail or Shavegrass and there is a note in his *English Flora* (1828):

'That eminent chemist Sir Humphry Davy first detected a quantity of pure silex, or flinty earth, in the furrowed cuticle of this plant, which accounts for its power, as a file in polishing wood, ivory or even brass. This purpose it has long served in England, under the name of Dutch Rushes, being usually imported from Holland.'

In 1972, whilst looking for *Potamogeton* hybrids in the water of Langmere, one of the Breckland meres, a plant was found which had both flowered and was fruiting submerged in some 45 cm of

water. This was the very rare *Alisma gramineum* subsp. *gramineum*, the third British record; a week later it was found near Manea in Cambridgeshire in a similar habitat. Common to both these places are the large numbers of wild-fowl and there is little doubt that it was brought in by wild-fowl on migration from Denmark and the Baltic States where this species is native. There is evidence that seeds of many aquatic species can remain viable in the intestinal tracts of wild-fowl and the hard pericarps of this species of Water Plantain are admirably adapted for transport over long distances.

It has been shown that in the course of 50 years the number of flowering plants and ferns recorded from Norfolk has grown from 1,208 to 1,701. Admittedly, modern segregates have added their quota, for example, we now have 85 microspecies of *Taraxacum* and vie with Kent for first place, but there are certainly no grounds for pessimism or dejection. In January 1976 we suffered from terrific gales and many thousands of trees were uprooted, and it will take several years for the Forestry Commission to clear away the damage; available supplies of timber far outstrip the demand. There are, too, many elms suffering from Dutch elm disease. To all this may be added the fact that landowners are having second thoughts about replanting, for they claim that under the prevailing Capital Transfer Tax the government's demands amount to three out of every four trees planted. However, even this setback has its compensations for botanists for, with the opening of a hitherto closed canopy and larger areas of open woodland, there is every likelihood of dormant or long-buried seeds germinating thereby giving a richer ground flora.

What of the future? The Norfolk Naturalists' Trust was the first of its kind to be formed and we now have some 30 Reserves covering more than 5,000 acres. We enjoy the enlightened policy of many landowners, particularly the Earl of Leicester who has created a coastal 'Green Belt' at Holkham. There are many Sites of Special Scientific Interest, the responsibility of the Nature Conservancy. With a rapidly expanding population and industrial development there will be additional claims for space, but doubtless we shall be keeping a close watch and employing every means available for the conservation and preservation of our rich heritage.

Watsonia, **11**, 195–198 (1977).

Atriplex praecox Hülphers: a species new to the British Isles

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ABSTRACT

Atriplex praecox Hülphers, a native species new to the British Isles, is described. This species is known from Greenland, Iceland, northern Norway and adjacent U.S.S.R. and on the Baltic coasts of Sweden, Finland and Estonia. Collections from Kylestrome and Ullapool in north-western Scotland confirm its presence in the British Isles. Its relationship to other members of the *A. prostrata* group is defined. A key to the *A. prostrata* group is provided and the presence of *A. longipes* Drejer in the British Isles is confirmed.

THE *ATRIPLEX PROSTRATA* GROUP

The *Atriplex prostrata* group comprises a number of partially interfertile and morphologically similar taxa found on the coasts of western Europe and elsewhere. It is represented in the British Isles by the following species: *A. prostrata* DC. (*A. hastata* auct.), *A. glabriuscula* Edmondston, *A. longipes* Drejer, and *A. praecox* Hülphers.

Atriplex prostrata, the most widespread member of the group, is commonly known as *A. hastata* L. (Tutin 1962, Aellen 1964, Jones 1975b); this name is a *nomen ambiguum* (Taschereau 1972, Jones 1975a). The name *A. triangularis* Willdenow, used by Taschereau (1972), Gustafsson (1973a, 1973b, 1974) and Jones (1975a), refers to the same taxon. Gustafsson (1975) has shown that the legitimate name for *A. hastata* auct. is *A. prostrata* Boucher ex DC. It is common throughout much of the British Isles and is the only member of the group also occurring inland. It is a component of inland salt-marsh vegetation and a transient colonizer of freshly disturbed soil.

Atriplex glabriuscula is common to abundant in sand or shingle around the coasts of the British Isles except in areas disturbed by excessive grazing or heavy human recreational use. This extremely variable species can be reliably distinguished only by the following combination of characters: Bracteoles thick-spongy with their margins united to the middle; seeds mostly dark brown to black, ovate to orbicular, irregularly biconvex; radicle median and ± strongly ascending, diameter 2·0–4·0 mm. Edmondston's (1845) original collection from Baltasound, Unst, Shetland, v.c. 112 is not extant. The neotype selected by Gustafsson (1975) is: Keiss, near Wick, Caithness, v.c. 109, 19.9.1930, leg. M. L. Wedgewood (K).

Atriplex praecox is a coastal halophyte restricted to meadows with short vegetation and to shingle on exposed coasts, above the high-water fucoid zone but below the zones occupied by most other terrestrial halophytes. Its distribution is disjunct, with populations in Greenland, Iceland, northern Norway and adjacent U.S.S.R., and on the Swedish, Finnish and Estonian coasts of the Baltic Sea. It is now known from two localities in north-western Scotland and is described in detail below. The identity of the British specimens has been confirmed by M. Gustafsson.

Atriplex longipes is a coastal halophyte occurring in tall vegetation communities dominated by species such as *Scirpus maritimus* and *Phragmites australis*. Its area of distribution is primarily in southern Fennoscandia. *Atriplex longipes* was first reported in the British Isles by Hulme (1957), and later by Aellen (1964) based on data provided by Hulme. Jones (1975a) briefly described *A. longipes* and comparable plants from the upper zones of sandy shores in S. Somerset, v.c. 6, and northern W. Norfolk, v.c. 28. She tentatively referred these to *A. longipes*, noting that this species was less common in Britain than suggested by Hulme. *A. longipes*, now known with certainty from a locality in south-western Scotland, is discussed in detail below.

The above four species may be separated by the following key:

1. Bracteoles spongy-inflated, margins united up to the middle; radicle up-pointing .. .. *A. glabriuscula*
1. Bracteoles thin, herbaceous or membranous, margins united only at the base; radicle out-pointing
   2. Axillary bracteoles with stalks 5–20 mm .. .. *A. longipes**
   2. Axillary bracteoles sessile or with stalks up to 3 mm
      3. Lower leaves triangular-hastate, subcordate to truncate or broadly obtuse at base; basal angle exceeding 160° .. .. *A. prostrata*
      3. Lower leaves lanceolate to rhombic-ovate, cuneate to attenuate at base; basal angle less than 140° .. .. *A. praecox*

* Conspicuously stalked bracteoles also commonly occur in *A. longipes* hybrids.

The following diagnostic characters require explanation. Leaf size and outline show extreme variation from the base to the apex of the plants in this group. The most constant and characteristic leaves are those on the central axis in the middle portion of the plant. Leaves in this region, about half way between the base and the terminal inflorescence, are called 'lower leaves'. Such leaves frequently drop off before the bracteoles and seed are fully mature.

The position of the seed radicle and its direction are important taxonomic characters. The fruit is a nut enclosed by two herbaceous, thick or thin bracteoles. Surrounding the seed is a loosely or firmly attached membranous pericarp with the vestiges of the style situated at the top. The outline of the radicle becomes visible on the seed margin when the lower portion of the pericarp is teased away. The radicle may emerge from the middle portion of the seed margin ('median') or from the base of the seed ('basal'). The radicle apex may be directed upwards towards the style vestiges ('up-pointing') or outwards at a right angle to the style axis ('out-pointing').

ATRIPLEX PRAECOX HÜLPHERS

Atriplex praecox can be separated from related species and hybrids by the following combination of characters:

Plants small, commonly 8–10 cm high, erect or ascending, sometimes with the lowermost branches elongating and spreading, often reddish. Lower leaves lanceolate to rhombic-ovate, usually with one or a pair of small divergent to ascending basal lobes, otherwise mostly entire, cuneate to attenuate at base. Bracteoles rhombic-ovate, thin-herbaceous or membranous, entire, free to the base, often barely exceeding the frequently visible, bulging nut, sessile or with a minute stalk up to 3 mm. Seeds black, lustrous, biconvex, 1·2–2·5 mm wide, with a sub-basal, out-pointing radicle; pericarp translucent, firmly attached to the seed.

The following collections from Scotland represent the first records of this species from the British Isles:

Kylestrome, W. Sutherland, v.c. 108, 4th September 1975, *Taschereau 75–85* (**MANCH**)
Ullapool, W. Ross, v.c. 105, 5th September 1975, *Taschereau 75–89* (**MANCH**)

The plants at Kylestrome occurred on shingle. *A. praecox* was the only species present in the small area examined and about 90% of the plants consisted of the reddish spreading form; the remaining plants, also spreading, were green. The plants at Ullapool were smaller and more erect. Here they formed a distinctive reddish zone amongst shingle just above the high-water fucoid zone in a region devoid of other terrestrial species. M. Gustafsson (*in litt.* 1975) noted that the Ullapool specimens are very similar to those collected by himself in the northernmost parts of Norway.

The fruiting period is August to September in north-western Scotland.

Turesson (1922a, 1922b) regarded *A. praecox* as an ecotype of *A. longipes* and later (Turesson 1925) treated it as a subspecies: *A. longipes* Drejer subsp. *praecox* (Hülphers) Turesson. Gustafsson (1975) followed Turesson in ranking *A. praecox* as a subspecies of *A. longipes*, but I prefer to treat it as a separate species. Throughout most of its distribution it is morphologically distinct and occupies a characteristic ecological niche. In the British Isles, at least, it is as distinctive as other taxa in the *A. prostrata* group.

Gustafsson (1972) recorded that about 30% of his artificial hybrids between *A. longipes* and

A. praecox were almost fully fertile; only populations of *A. praecox* from Norway gave rise to semi-sterile hybrids with *A. longipes*. Natural hybrids between *A. praecox* and *A. longipes* are reported as rare in the Baltic area of coastal Sweden (Gustafsson 1972, 1975), but they have not been reported from the British Isles.

ATRIPLEX LONGIPES DREJER

A. longipes can be separated from related species and hybrids by the following combination of characters:

Plants erect to ascending with elongated lower lateral branches, up to about 80 cm high in tall vegetation. Lower leaves narrowly triangular with a pair of weakly developed out-pointing basal lobes, otherwise mostly entire, cuneate at the base. Bracteoles elongate-triangular to rhombic, thin, herbaceous, entire except for distinctly developed pointed basal lobes, surface often strongly reticulate-veined especially toward the base, margins united only at the base, the axillary bracteoles with conspicuous stalks 5–20 mm long.

As mentioned above, this species has been reported from the British Isles by Hulme (1957) and Jones (1975a). I have examined Hulme's collection in **LIV**, and Jones's specimen in **OXF**. The material, particularly that of Jones, is strongly reminiscent of *A. longipes* but not sufficient to permit a certain identification. The presence of *A. longipes* in the British Isles has been confirmed, however, by my collection from a stand of *Phragmites australis* in the north-east of Wigtown Bay, Kirkcudbright, v.c. 73, 9th September 1975, *Taschereau 75–97* (**MANCH**). The specimens were compared with Scandinavian material in **LD** and my determination has been confirmed by M. Gustafsson.

The distribution of *A. longipes* in Britain is still to be resolved.

ATRIPLEX GLABRIUSCULA × *A. PRAECOX* AND OTHER HYBRIDS

Gustafsson (1975) produced artificial hybrids of varying fertility between *A. praecox* and each of the members of the *A. prostrata* group. In crosses between *A. glabriuscula* and *A. praecox* the mean male fertility value (F_1) was 60–80% (Gustafsson 1973a). Gustafsson (1975) noted that the occurrence of natural hybrids between these two species was rare in northernmost parts of Norway.

Specimens presumed to be *A. glabriuscula* × *A. praecox* have been collected from Scotland:

Tongue, W. Sutherland, v.c. 108, 1st September 1975, *Taschereau 75–83B* (**MANCH**); and Ullapool, W. Ross, v.c. 105, 5th September 1975, *Taschereau 75–89B* (**MANCH**). The specimens agree with Gustafsson's (1975) description: stems prostrate to ascending, larger than in *A. praecox*, green or reddish; leaves ± similar to those of *A. praecox*; bracteoles rhombic, much thicker than in *A. praecox*, margins united to the middle; radicle out-pointing, sub-ascending.

These specimens represent the first record of this hybrid in the British Isles.

Other natural hybrids in the *A. prostrata* group reported from Scandinavia by Gustafsson (1975) are: *A. glabriuscula* × *A. longipes* (rare in the western parts of Scandinavia with one record from Bodö in Norway); *A. glabriuscula* × *A. prostrata* (relatively rare in the western parts of Scandinavia); *A. longipes* × *A. prostrata* (common along the west coast of Sweden northwards to the southern parts of Norway; relatively rare in Denmark; rare in the Baltic area. The taxon called *A. longipes* subsp. *kattegatense* Turesson is one nothomorph of this hybrid (Gustafsson 1973b)); *A. praecox* × *A. prostrata* (common in the northern parts of Norway). None of these has yet been found in the British Isles.

ACKNOWLEDGMENTS

This work was done while the author was the holder of a Postgraduate Scholarship from the National Research Council of Canada. I should also like to thank Dr M. Gustafsson for the valuable help he has given me.

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(*Accepted July* 1976)

Lychnis alpina L. in Britain

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ABSTRACT

Soils from two British sites of *Lychnis alpina* L. were analysed and shown to have very different chemical composition. Plants from the two sites were grown on both soils under controlled conditions and the differing responses indicated that each site has a distinct edaphic race of the species. The restricted occurrence in Britain of *L. alpina* is discussed in relation to soil factors.

INTRODUCTION

Lychnis alpina L. (*Viscaria alpina* (L.) G. Don fil.) has two main sites in Britain, at Hobcarton Crag in the English Lake District (Cumberland, v.c. 70), and near the hill called Meikle Kilrannoch at the head of Glen Doll in Forfar, v.c. 90, Scotland. (A second Lake District site, near Coniston, Furness, v.c. 69b (Potter 1880), requires confirmation and, on the island of Rhum, Mid Ebudes, v.c. 104, plants recorded by Heslop-Harrison *et al.* (1943) need further investigation of their indigeneity and indeed their survival). There are about 150 plants at Hobcarton (Ratcliffe 1960) whilst there are very many more than this at Meikle Kilrannoch. It has been suggested (Raven & Walters 1956) that the Hobcarton site is associated with a pyritic vein, and the data of Ratcliffe (1960) support this to some extent. The site at Meikle Kilrannoch is a well-known serpentine area (Proctor & Woodell 1971). For both sites it was felt desirable to collect more soil data on both exchangeable and total quantities of elements in the hope that they would provide some explanation of the species' restricted occurrence in Britain.

SOIL ANALYSES

Soil samples were collected from as close as possible to established *L. alpina* plants without disturbing them. Seven samples (H1–H6, H10) were taken at Hobcarton in August 1969 and five samples (MK1–MK5) from Meikle Kilrannoch in August 1975. Analyses were carried out on air-dried samples. pH was measured in a 1:1 soil:deionized water mix. Exchangeable cations were extracted with 1 M ammonium acetate adjusted to a pH value similar to that of the soils, i.e. pH 4·2 for the Hobcarton samples and pH 7 for the Meikle Kilrannoch samples, and analysed by atomic absorption spectrophotometry.

In addition, subsamples were sent to the Macaulay Institute for Soil Research, Aberdeen, for semiquantitative spectrographic analyses of total quantities of elements.

The analyses (Tables 1–4), which include three samples (H7–H9) from Ratcliffe (1960), clearly show that the British sites of *L. alpina* bear two very different soils.

Judging from the data of Swaine (1955), there is little abnormal in the total quantities of elements in the soils at Hobcarton apart from the high manganese with associated cobalt in samples H1 and H2.

The exchangeable cation analyses, however, suggest some further local soil abnormalities. In Ratcliffe's samples (H7–H9), copper levels are very much higher than the 'Up to *c* 1 ppm' which Swaine (1955) gives as being water or dilute acid extractable in normal soils (Ratcliffe surprisingly regarded these copper levels as being 'only in average concentration compared with most soils'). Our own analyses show exchangeable copper levels up to 3·5 ppm, and presumably indicate different soil sample collecting points from those of Ratcliffe. Exchangeable manganese ranges from

TABLE 1. TOTAL TRACE ELEMENT CONCENTRATIONS IN SOILS FROM THE ROOTING ZONE OF *LYCHNIS ALPINA* L. FROM HOBCARTON

Sample No.	Concentration in p.p.m. in dry soil																				
	Ag	Ba	Be	Co	Cr	Cu	Ga	La	Li	Mn	Mo	Ni	Pb	Rb	Sc	Sn	Sr	Ti	V	Y	Zn	Zr
H1	2	1,500	10	400	100	300	25	150	800	20,000	<1	60	200	800	10	<3	200	9,000	150	40	<1,000	100
H2	2	1,000	10	1,500	100	300	25	150	250	30,000	1	60	150	400	10	<3	100	6,000	150	60	<1,000	100
H3	<1	800	8	30	80	80	25	100	150	6,000	1	30	250	500	10	<3	120	6,000	120	50	<800	80
H4	<1	1,000	10	40	150	100	30	150	200	8,000	1	40	200	600	10	<3	150	8,000	150	80	<1,000	150
H5	<1	1,000	10	30	150	200	30	200	250	3,000	1	30	60	800	15	<3	200	8,000	150	100	<1,000	300
H6	1	800	8	30	120	80	25	200	120	3,000	1	30	200	500	8	<3	120	6,000	120	60	<800	250
H10	<1	1,000	6	10	150	40	30	200	250	400	<1	15	30	800	10	<3	200	8,000	200	60	<1,000	300

TABLE 2. EXCHANGEABLE CATIONS IN SOIL FROM THE ROOTING ZONE OF *LYCHNIS ALPINA* L. FROM HOBCARTON

Sample No.	pH	m-equiv. per 100 g				p.p.m.		
		Ca	Mg	K	Na	Cu	Mn	Fe
H1	n.d.	0·18	0·17	0·37	0·33	3·5	144	59
H2	4·0	0·25	0·23	0·21	0·37	3·0	110	89
H3	4·1	0·35	0·28	0·31	0·15	2·0	37	158
H4	4·0	0·18	0·12	0·34	0·19	2·0	16	185
H5	4·2	0·16	0·13	0·20	0·19	1·0	20	160
H6	4·1	0·17	0·17	0·21	0·18	3·5	73	254
H7*	4·4	0·33	0·20	0·20	0·14	82	104	24
H8*	4·0	0·17	0·025	0·14	0·06	91	214	77
H9*	5·2	0·34	0·17	0·17	0·10	29	25	5

* Data calculated from Ratcliffe (1960).

TABLE 3. TOTAL TRACE ELEMENT CONCENTRATIONS IN SOILS FROM THE ROOTING ZONE OF *LYCHNIS ALPINA* L. FROM MEIKLE KILRANNOCH

Sample No.	Concentration in p.p.m. in dry soil																				
	Ag	Ba	Be	Co	Cr	Cu	Ga	La	Li	Mn	Mo	Ni	Pb	Rb	Sc	Sn	Sr	Ti	V	Y	Zn	Zr
MK1	<1	250	<10	<60	12,000	40	20	<10	20	900	<1	800	100	30	30	<10	40	6,000	300	10	<1,000	100
MK2	<1	150	<10	80	16,000	30	15	<10	20	1,100	1	1,600	80	10	20	<10	25	5,000	200	6	<1,000	60
MK3	1	200	<10	80	6,000	20	15	<10	15	2,500	1	1,200	80	20	20	<10	60	5,000	150	10	<1,000	60
MK4	1	150	<10	60	5,000	20	15	<10	10	1,000	1	1,200	60	10	20	<10	60	5,000	100	10	<1,000	100
MK5	1	300	<10	<60	2,000	15	20	<10	20	1,600	<1	600	40	20	15	<10	100	6,000	150	30	<1,000	60

TABLE 4. EXCHANGEABLE CATIONS IN SOIL FROM THE ROOTING ZONE OF *LYCHNIS ALPINA* L. FROM MEIKLE KILRANNOCH

Sample	pH	m-equiv. per 100 g				p.p.m.							
		Ca	Mg	K	Na	Ni	Cr	Co	Fe	Cu	Mn	Zn	Al
MK1	6·6	1·1	8·9	0·07	0·05	20·0	0·5	<0·1	<0·1	<0·1	1·1	0·2	14·0
MK2	6·9	1·0	9·8	0·09	0·06	12·5	<0·1	<0·1	<0·1	<0·1	0·9	0·3	5·0
MK3	7·1	1·2	9·8	0·06	0·05	6·0	0·8	<0·1	<0·1	0·1	0·5	0·4	<0·1
MK4	7·3	0·7	8·2	0·06	0·04	7·5	<0·1	0·7	<0·1	0·2	0·2	0·2	10·0
MK5	7·2	0·5	7·7	0·07	0·04	5·5	<0·1	<0·1	<0·1	<0·1	0·3	0·7	7·0

16 to 214 ppm, exchangeable iron from 5 to 254 ppm. These levels do not seem outstandingly high. For example, Gupta & Rorison (1975) found up to about 80 ppm exchangeable manganese and about 280 ppm exchangeable iron in a brown podzolic soil supporting undistinctive grassland in Derbyshire.

The analyses for Meikle Kilrannoch show the characteristic features of serpentine soils (Proctor & Woodell 1975) and have high total levels of nickel and chromium and exchangeable nickel. The exchangeable magnesium/calcium ratio at this site is amongst the highest of British serpentine soils and has been demonstrated by Proctor (1971a, b) to be a major cause of the extremely toxic conditions there.

ARE THERE TWO RACES OF *LYCHNIS ALPINA* IN BRITAIN?

An important question is whether *L. alpina* is a plant of wide tolerance or whether it has evolved separate races in response to the differing edaphic conditions at each of the known British sites. This was investigated by growing plants from seed collected from both sites on both soil types.

Soil and a small quantity of seeds were collected from Hobcarton and Meikle Kilrannoch in August 1975. The seeds were stored in laboratory conditions for approximately six weeks and then germinated, without pre-treatment, on filter papers. Seedlings were transferred to 8 cm diameter plastic pots of soils and two plants from the same site were grown in each pot. A randomized block experimental design was used, with five blocks each with one replicate of each treatment. John Innes Potting Compost No. 2 (J.I.) was used as a reference treatment. Plants were grown in the soils from 7th October 1975 to 12th December 1975 at 16°C and with 16 h supplementary light daily. The aerial parts were then harvested, dried at 85°C and weighed. The results (Table 5) were subjected to three separate analyses of variance because of very large differences in variance between plant weights on the three soil types.

TABLE 5. MEAN DRY WEIGHT (mg)±S.E. OF TWO PLANTS OF *LYCHNIS ALPINA* L. GROWN ON DIFFERENT SOILS

Seed source	Soils		
	J.I.	Meikle Kilrannoch	Hobcarton
Meikle Kilrannoch	292·8±116·0	4·2±0·42	5·2±6·4
Hobcarton	540·2±116·0	0·8±0·42	34·3±6·4

Both races of plants grew vigorously on J.I., without any symptoms of nutrient deficiency. Differences in dry weight between the two races fell short of statistical significance at the 5% level. In the Hobcarton soil, the Hobcarton plants grew well, whilst the Meikle Kilrannoch plants were very small, stunted and in some cases showed both chlorosis and reddening. Dry-weight differences were significant at the 5% level. In the Meikle Kilrannoch soil the Hobcarton plants were very small and chlorotic, in contrast to the larger Meikle Kilrannoch plants, which were healthy in appearance. Dry-weight differences were significant at the 1% level.

DISCUSSION

The two known populations of *Lychnis alpina* in Britain occur on soils of very different chemical composition and the species has apparently evolved separate races in response to these.

The soil samples from Hobcarton show some unusual features but none which would not be expected at pyritic outcrops elsewhere in Britain. The flora associated with *L. alpina* there is of commonplace species with the exception, noted by Ratcliffe (1960), of *Grimmia atrata*, a rare moss which is reputedly particularly associated with copper-bearing rocks (Mårtenssen & Berggren 1954). By contrast with the unremarkable Hobcarton soils, the samples from Meikle Kilrannoch reveal a

very unusual chemical composition at a site which is at a higher altitude (*c* 850m) than most other British serpentines. The flora associated with *L. alpina* there includes a number of very local species (Proctor & Woodell 1971).

The abundance of *L. alpina* at Meikle Kilrannoch and its well-documented occurrence on serpentines elsewhere (e.g. Knaben 1950) suggested that tissues of this race of the species should be analysed to investigate if the plants accumulated abnormal quantities of any unusual elements. A small number of leaves of *L. alpina* (from soil sample collecting points MK1–3) were digested in concentrated nitric acid and analysed by atomic absorption spectrophotometry. The results (Table 6) show no extreme accumulations of elements compared with some examples discussed by Proctor & Woodell (1975), and the concentrations are all within the ranges measured for other species at this site (Johnston unpublished).

TABLE 6. ELEMENT CONTENT OF LEAVES OF *LYCHNIS ALPINA* L. FROM MEIKLE KILRANNOCH

Sample No.*	m-equiv. per 100 g dry tissue			
	Ca	Mg	K	Na
MK1	57·7	137·1	187·2	17·3
MK2	42·0	147·7	174·5	11·5
MK3	57·7	216·2	148·8	23·0

Sample No.*	p.p.m. dry tissue							
	Ni	Cr	Co	Fe	Cu	Mn	Zn	Al
MK1	88·4	89·7	26·3	256·1	19·1	35·2	50·0	63·2
MK2	64·9	68·3	12·3	206·4	10·5	31·7	47·0	66·6
MK3	70·8	93·3	16·9	270·7	6·3	42·2	47·0	63·2

* Numbered as in Tables 3 and 4.

At Meikle Kilrannoch there is a puzzling difference in the numbers of *L. alpina* plants on the two main serpentine outcrops, which are less than 1 km apart. *L. alpina* is common on the northern outcrop, yet Proctor & Woodell (1971) reported the species to be absent from the southern outcrop. A search of the latter in June 1976 revealed a single specimen. The soil analyses in this present paper all refer to the northern outcrop. Preliminary comparisons of the soils of the southern with those of the northern outcrop (Proctor & Woodell 1971) revealed no gross differences in chemical composition although we are currently subjecting the soils of the southern outcrop to a more critical reinvestigation.

It is curious that, in Britain, *L. alpina* should be restricted to certain pyritic and serpentine outcrops since elsewhere the species grows on a wide variety of preponderantly neutral to basic soils. Dr G. Halliday (pers. comm. 1976) pointed out, for example, that in southern Greenland the species is widespread and apparently shows no particular preference for heavy metal/ultrabasic soils. In view of this, and taking into account other observations such as the unremarkable nature of at least some of the Hobcarton soil samples, we believe that there are many sites in Britain which appear to provide suitable soil chemical conditions for *L. alpina* and that the factors limiting its distribution here are at present unknown.

ACKNOWLEDGMENTS

We should like to thank Dr R. L. Mitchell and staff at the Macaulay Institute for Soil Research, Aberdeen, for their analyses of total levels of elements in the soils, and Professor C. D. Pigott for his assistance at the Hobcarton site. The Nature Conservancy Council is acknowledged for permission to work at Meikle Kilrannoch.

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(*Accepted July* 1976)

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A hybrid swarm between the diploid *Dactylorhiza fuchsii* (Druce) Soó and the tetraploid *D. purpurella* (T. & T. A. Steph.) Soó in Durham

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ABSTRACT

A study was made of the pollen grain meiosis and floral characters of a random sample of a population of diploid *Dactylorhiza fuchsii* (Druce) Soó, tetraploid *D. purpurella* (T. & T. A. Steph.) Soó and apparent hybrids in a limestone quarry in Co. Durham. Eudiploids, eutetraploids and a predominance of eutriploids were found, but about a quarter of the population were aneuploid, with chromosome numbers $2n = 44$, 48, 52 and 72. A hybrid index showed that a wide range of hybrids occurred. Eutriploids, presumed to be F_1 hybrids, were very variable. They showed a wide range of univalents at meiosis, with a (rare) maximum of 20. The appearance of aneuploids was consistent with an F_2, backcross, or subsequent origin. It is suggested that population differentiation in tetraploid *Dactylorhiza* may be due to polytopic allopolyploid origin. Viability of aneuploid gametes and hybrids may be due to ancestral polyploidy. The situation is unusual because extensive F_2 and backcross hybridization seems to occur across a diploid/tetraploid barrier.

INTRODUCTION

It has long been recognized that many of the taxonomic problems associated with the genus *Dactylorhiza* in the British Isles arise from hybridization (Stephenson & Stephenson 1922). Populations containing many and varied morphological intermediates between the diploid *D. fuchsii* (Druce) Soó ($2n = 40$) and the tetraploids *D. purpurella* (T. & T. A. Steph.) Soó and *D. praetermissa* (Druce) Soó ($2n = 80$) have been studied by Heslop-Harrison (1953, 1957). His main conclusions (cited by Roberts (1975)) were that hybrids are eutriploids ($2n = 60$), although very variable, and show a high level of seed-sterility. He suggested that the few embryos which are produced arise parthenogenetically, being themselves eutriploid, and that backcrossing to parents or crossing between triploids is unlikely to occur, although the possibility is not ruled out. No aneuploids were discovered.

A more recent study (Richards 1963) of mixed populations of *D. fuchsii* and *D. purpurella* in recently abandoned magnesian limestone quarries in Durham, v.c. 66, suggested that the situation there was a more complex one. These populations contained a wide range of phenotypes, many of which showed varying degrees of intermediacy between the two species, and were morphologically consistent with extensive backcrossing of the F_1 hybrid to both parents. Furthermore, out of nine reliable chromosome counts which were made from pollen grain mitosis, two proved to be aneuploid with $n = 22$ and 37.

It also seemed that other populations occurring in long-disused magnesian limestone quarries and consisting of robust plants with broad, shallowly trilobed labella resembling T. and T. A. Stephenson's *Orchis purpurella* 'Form B' (Stephenson & Stephenson 1922), may have arisen as a result of introgression from *D. fuchsii* into *D. purpurella*.

The present work was undertaken to establish whether aneuploids of presumptive backcross origin were important in Durham populations of *Dactylorhiza*.

MATERIALS

Buds were fixed from 50 individuals in a mixed population of parent species and apparent hybrids at Quarrington, Durham, v.c. 66 (G.R. 45/330.364), on the 14th June 1974. Plants were chosen using a 1m grid and a table of random numbers. The latter generated pairs of numbers to indicate

grid intersections, and buds were fixed from the nearest flowering spike with only the bottom one or two flowers open. The labellum of the most open flower was preserved on card under transparent adhesive tape.

METHODS

Buds were fixed in 3:1 absolute ethanol/glacial acetic acid overnight and then kept in the deep-freeze. After hydrolysis in N hydrochloric acid at 60°C for 15 minutes, they were stained in Feulgen stain for 1 hour. Pollinia were excised and squashed in acetocarmine. Slides showing meiotic stages were made permanent in 'euparal'. As pointed out by Heslop-Harrison (1953), meiosis is highly synchronized; in suitable preparations large numbers of dividing cells can be observed.

The following characters (Fig. 1) were scored from the preserved labella:

1. maximum width
2. maximum length
3. vertical length of central lobe (if any) from apex to sinus
4. shape: deltoid, intermediate, trilobed
5. colour: white to pink, deep-pink, red-purple
6. markings: spots, intermediate, rings.

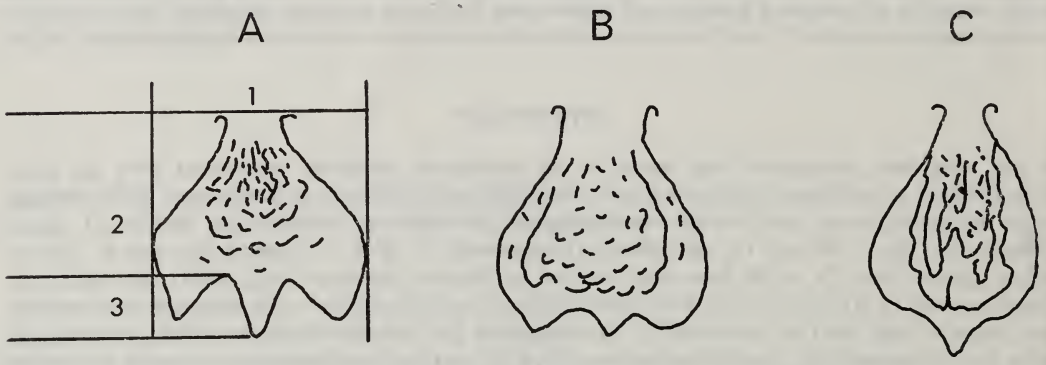

FIGURE 1. Labellum types in *Dactylorhiza*. A, *D. fuchsii*, trilobed labellum with spots; B, labellum of putative hybrid with intermediate shape and markings; C, *D. purpurella*, deltoid labellum with rings. Measurements: 1, maximum width; 2, maximum length; 3, vertical length of central lobe.

Individuals with eudiploid ($2n = 40$) and eutetraploid ($2n = 80$) chromosome counts were assumed to be pure *D. fuchsii* and *D. purpurella* respectively.

Somatic chromosome numbers were calculated from meiotic preparations by counting the number of univalents and bivalents in a number (usually about 50) cells in each individual. Some apparent variation (up to 3 chromosomes per cell) was noted within an individual plant. This is thought to be due to chromosomes being obscured, or to the occasional misinterpretation of univalents and bivalents, rather than actual variation.

RESULTS

Meiotic stages (diakinesis to metaphase I) which allowed the accurate determination of somatic chromosome number were found in 33 individuals. Of these, 5 were eudiploid ($2n = 40$), 7 were eutetraploid ($2n = 80$) and 13 were eutriploid ($2n = 60$). The remaining 8 were aneuploid, with $2n = 44$, 48, 52 and 72 (Table 1).

In 13 plants, all triploids or aneuploids, a sufficient number of cells could be analysed for the variation in the number of univalents within one plant to be counted (Table 2). Only univalents

TABLE 1. SOMATIC CHROMOSOME NUMBERS

$2n =$	No. plants	Ploidy level
40	5	Eudiploid
44	2	
48	2	
52	1	
60	13	Eutriploid
72	3	
80	7	Eutetraploid

and bivalents were seen, so counts apparently of odd numbers of univalents are probably instances of experimental error. Eudiploids and eutetraploids invariably showed regular formation of bivalents and regular disjunction.

It will be seen that a single individual may show a wide range in the number of univalents occurring in a meiotic cell. Among the triploids, individuals do not differ greatly as to mean number or range of univalents found, although the small range in plant number 2 and the high mean number in plant number 30 seem to differ from the rest. The number of univalents in an individual does not follow a normal distribution, but shows distinct peaks at 9 and 12, with perhaps a subsidiary peak at 15. 20 univalents, as constantly recorded by Heslop-Harrison (1953), rarely occurred. As might be expected, the numbers of univalents are less in subtriploid aneuploids, but here also there is a suggestion of a double peak in the distribution.

The fate of the univalents is not known for certain. Limited studies of anaphase I and the second meiotic division suggest that most, if not all, migrate to one pole at anaphase I and are incorporated in one daughter nucleus. Bivalents in triploids behave normally, with regular disjunction (of 20 or more chromosomes) to each pole.

Pure populations of the parent species are rare in Co. Durham, and therefore eudiploid and eutetraploid individuals from Quarrington were used to define the morphological limits of the two species. This has the advantage of removing bias arising from phenotypic differences between populations of the same species. However, introgressive hybridization at the euploid level would not be detected.

It was found that the length, width and the length/width ratio of the labellum showed no signi-

TABLE 2. NUMBERS OF UNIVALENTS OBSERVED IN INDIVIDUAL CELLS AT METAPHASE I IN TRIPLOIDS AND ANEUPLOIDS

Plant	$2n =$	Numbers of univalents																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	60				3	6	4	2	8	6	5	3	2	2	1	3	3		2		
2	60							4	6	9	4	10	17								
3	60					2	1	3	2	3	4	6	6	4	4	2					
6	60				4	2		5	8	3	7	2	9	2		4	3		4		
12	60				3	1	2	5	3	7	2	7	7	1	1	2	2		1		
30	60										3		2	5	3	4	6	3	1	1	1
36	60				1		2	1	4	5	4	4	3	4	4	5	2	1			
39	60				1	1	1	1	4	6	1	4	3	2	1	3	2		2		1
43	60						1	1	1	3	3	4	2	2	2		3		1		
47	60			1	2		2	1	4	5	2	5	4	3	1	3	2	1		1	1
Totals ($2n = 60$)				1	14	12	13	23	39	47	35	45	55	25	17	26	23	5	11	2	3
38	48		2		2	7	5	9	4	3	2	2	1		1						
44	48		3	3	4	5	4	7	11	3											
Totals ($2n = 48$)			5	3	6	12	9	16	15	6	2	2	1		1						
50	52		1	2	6	3	2	2	2	2		1	2								

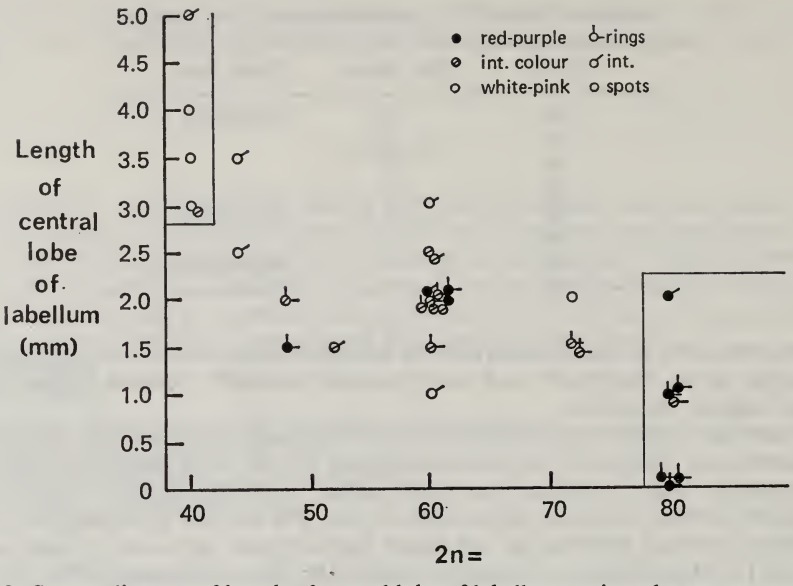

FIGURE 2. Scatter diagram of length of central lobe of labellum against chromosome number.

ficant difference between diploids and tetraploids, and these characters were not used. However, the other characters scored were considered to show such differences (Fig. 2), and it proved possible to combine these in a hybrid index (Table 3). Due to the occasional occurrence of intermediate characters in eudiploid and eutetraploid plants it was not found possible to obtain a 'pure' index score for euploid plants, but euploids could be effectively separated by this method (Fig. 3).

The distribution of hybrid index scores in the sample is rather uniform (Fig. 4), but with nearly half the individuals morphologically resembling *D. purpurella* (hybrid index 6–8). However, it is clear that a wide and continuous range of morphs occurs. The distribution of hybrid index scores

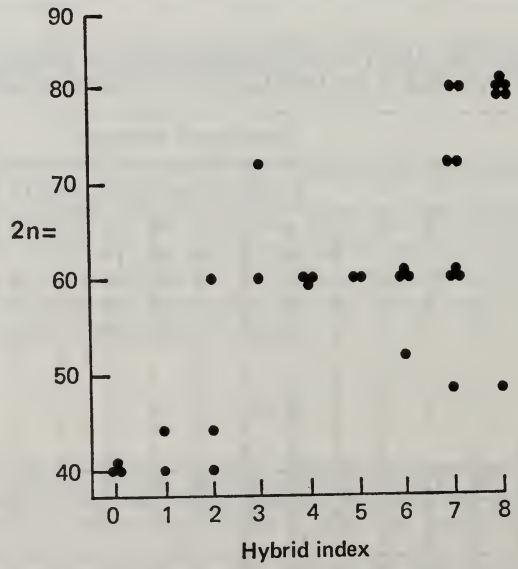

FIGURE 3. Scatter diagram of hybrid index against somatic chromosome number. Note separation of diploids and tetraploids, and wide morphological range of triploids.

TABLE 3. THE SCORING OF LABELLUM CHARACTERS USED IN THE CONSTRUCTION OF A HYBRID INDEX

	D. fuchsii	Intermediates	*D. purpurella*
Score	0	1	2
Length central lobe	3 mm +	2·1–2·9 mm	0–2·0 mm
Shape	Trilobed	Intermediate	Deltoid
Colour	White to pink	Intermediate	Red-purple
Markings	Spots	Intermediate	Rings

against chromosome number (Fig. 3) is of interest. Eudiploids ($2n = 40$) score 0–2, and eutetraploids ($2n = 80$) 7–8, two-thirds of euploids showing maximum differentiation (0 or 8). Eutriploids ($2n = 60$) have a wide range of hybrid index scores (2–7), although with very little overlap with diploids and tetraploids. These results confirm those of Heslop-Harrison (1957), who suggested that the wide range of intermediates occurring in hybrid populations of *Dactylorhiza* can be due to triploids, presumably of F_1 origin. However, in this population, about one-quarter of the plants are aneuploids, presumably of F_2, backcross or later generations. These plants show variable and often anomalous phenotypes. Although $2n = 44$ plants resemble *D. fuchsii*, $2n = 48$ and $2n = 52$ plants more closely resemble *D. purpurella*. $2n = 72$ plants are variable, with scores of 3 and 7.

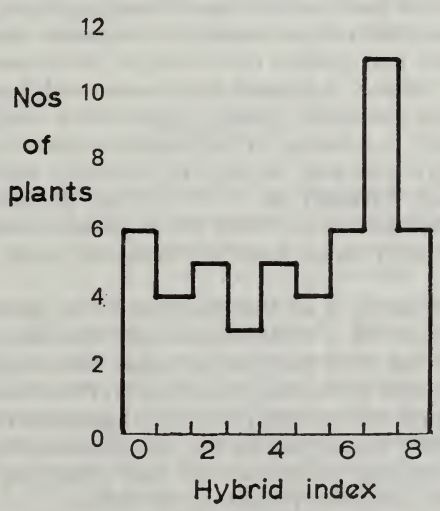

FIGURE 4. Distribution of hybrid index scores for all individuals.

DISCUSSION

It is usually considered that tetraploids are effectively reproductively isolated from related diploids, hybrid triploids showing a very high level of sterility. This can generally be shown to be due to the irregularity of meiosis in the triploid, with the formation of univalents and often trivalents resulting in meiotic products which are aneuploid and inviable. A few cases have been reported in which introgression may have occurred from a diploid to a tetraploid or vice-versa. However, in high polyploids, fertile hybrids between different ploidy levels are more common, presumably because the difference between gene dosages found in aneuploids is buffered by polyploidy.

Heslop-Harrison (1953, 1957) reported that diploid × tetraploid hybrids in *Dactylorhiza* were invariably triploid and highly sterile, and that 20 univalents were regularly formed (some of his figures show fewer univalents, perhaps due to some being masked by others). He considered that this result was consistent with an allopolyploid origin of the tetraploids *D. purpurella* and *D. praetermissa* (FFII) with one parent *D. fuchsii* (FF) and the other probably *D. incarnata* (L.)

Soó (II). This conclusion has not been doubted and is agreed with here. Indeed, it is possible that the allopolyploids *D. purpurella*, *D. praetermissa*, *D. majalis* (Reichb.) Hunt & Summerh. and *D. traunsteineri* (Sauter) Soó are the product of crosses between the various subspecies of *D. incarnata* and *D. fuchsii*, allopolyploidy having arisen polytopically.

In the present work, it was found that 20 univalents rarely occur in the triploid F_1 hybrid between *D. fuchsii* and *D. purpurella* (FFI), it being common to find between 4 and 18 univalents (and 21 and 28 bivalents). It is therefore likely that some homology exists between the F and I genomes. Unfortunately meiosis of the diploid hybrid *D. fuchsii* × *D. incarnata*, which is occasionally found (Roberts 1975), has not been described.

Where 20 univalents occur in the triploid F_1, fertility of the resulting gametes might depend on the segregation of the univalents. If they stayed together and migrated to one pole at anaphase I, euploid spores of $n = 20$ and $n = 40$ would be formed, which would probably produce viable gametes and result in diploid ($2n = 40$), triploid ($2n = 60$) or tetraploid ($2n = 80$) offspring. It is not inconceivable that the few triploid embryos reported by Heslop-Harrison (1953) originated in this way, rather than parthenogenetically as suggested.

The occurrence of a substantial number (24%) of aneuploids suggests that the triploids are by no means totally sterile, but may frequently cross among themselves, or backcross to the parents. Earlier meiotic studies of both parents (Richards 1963, and unpublished) confirm the results of Heslop-Harrison (1953) and the present work in that eudiploids and eutetraploids show a regular meiosis, and thus aneuploids are unlikely to have arisen except from triploids. The chromosome numbers of aneuploid hybrids of the F_2 or later generations are by no means randomly distributed (Table 1). This might suggest that certain somatic chromosome numbers are more viable but, equally, it may be due to the non-random occurrence of chromosome numbers in the meiotic products of the triploid F_1. Certainly, it appears that meioses with 9 and 12 univalents occur most frequently, and at least some aneuploid somatic chromosome numbers (48, 52, 72) might be explicable on this hypothesis if, as it seems, all univalents progress to one pole at anaphase I.

The apparent fertility of triploids may perhaps be explained through the suggestion that *D. fuchsii* is ancestrally polyploid. Certainly, $2n = 40$ is a high diploid number, and one count of $2n = 20$ is recorded in Bolkhovskikh *et al.* (1969) for *D. fuchsii*, although this might have been a parthenogenetic haploid. However, much lower chromosome counts are recorded in the related genus *Orchis*.

If it is assumed that *D. purpurella* is an allotetraploid with a genome from *D. fuchsii*, that *D. purpurella* has a regular meiosis with $n = 40$ gametes, and that the *D. fuchsii* genomes in the F_1 hybrid pair (the univalents being from the other genome), then the chromosome number of the hybrid can give an accurate picture of its degree of hybridity. Plants with $2n = 40$ will be *D. fuchsii*, and all additional chromosomes will be from the other (I) genome; thus the hybrid 'dose' in each individual can be rather strictly determined by the chromosome number, between $2n = 40$ and $2n = 80$. However, the morphology of hybrids will vary depending on which chromosomes of the I genome have, by chance, been incorporated in the hybrid.

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(*Accepted July* 1976)

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A cytological study of the Compositae (excluding *Hieracium* and *Taraxacum*) of the British Isles

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ABSTRACT

Chromosome numbers based on indigenous material are reported for 79 of the 97 species native in the British Isles. Counts for *Cirsium dissectum* (L.) Hill ($2n = 34$) and *C. tuberosum* (L.) All. ($2n = 34$) appear not to have been reported before. Also, chromosome numbers in 53 of the taxa are reported for the first time in material from the British Isles. A spectrum of polyploidy is given. The incidence of polyploidy in the Compositae of the British Isles is calculated to be 44·6%. The occurrence of dwarf, genetically maintained ecotypes in *Aster tripolium* L., *Leucanthemum vulgare* Lam., *Serratula tinctoria* L. and *Solidago virgaurea* L. is noted. The results of transplant experiments with *Solidago virgaurea* are discussed.

INTRODUCTION

The Compositae of the British Isles comprise 97 native species if the genera *Hieracium* (incl. *Pilosella*) and *Taraxacum* are excluded. The exclusion of these genera in the compilation of any statistics for the family is unfortunately necessary, for a combination of sexual and apomictic reproduction in them has led to the origin of a very large number of more or less stable and self-perpetuating genotypes. Though these are often treated as microspecies they cannot be equated with conventional species, and if included would radically distort any statistics. Other genera in the Compositae besides *Hieracium* and *Taraxacum* have developed forms of apomixis, but in the British Isles none of these have produced the wealth of variation and the great taxonomic complexity found in these two genera. An account of *Taraxacum* in the British Isles has recently been produced (Richards 1972) and includes full information on chromosome numbers. Chromosome numbers for some of the species of *Hieracium* in the British Isles have recently been published (Mills & Stace 1974, Morton 1974). Hybrids have been excluded from the present study. Currently available information on them is reviewed in Stace (1975).

The present study was undertaken as part of a survey of the incidence of polyploidy in this and other families. Publication has been delayed for many years in the hope that a more complete list could be produced. However, it now appears preferable to publish the available data without further delay. Chromosome numbers based on material of known origin are reported for 79 of the 97 native species, together with several alien species and a number of infraspecific taxa. Details of the plants studied, their chromosome numbers, ploidy level, and the location of voucher specimen are given in Table 1.

MATERIALS AND METHODS

Living material was collected in the field and brought into cultivation either by transplanting or by growing from seed. In most cases chromosomes were studied in root-tip preparations using a squash technique (Morton 1962). Root-tips were taken from well-grown plants to prevent anomalies arising from seedling root-tips or from misidentification of immature material.

TABLE 1. CHROMOSOME NUMBERS IN THE COMPOSITAE (EXCLUDING *HIERACIUM* AND *TARAXACUM*) OF THE BRITISH ISLES

Name (* = alien)	Collection No.[1] or reference	Vouchers[2]	Origin	2*n*	Base No.	Ploidy level (*x*)
ACHILLEA millefolium L.	Morton s.n.	**JKM**	Bowes, Barnard Castle, v.c. 65	54	9	6
A. ptarmica L.	4702	**DHM, JKM**	Westgate in Weardale, v.c. 66	18	9	2
**ANAPHALIS margaritacea* (L.) Benth.	Maude (1940)		British, unlocalized	28	7	4
ANTENNARIA dioica (L.) Gaertn. var. *dioica*	4778	**JKM**	Cul Mor, v.c. 105	28	7	4
A. dioica var. *hyperborea* (D. Don) DC.	A. J. Richards (pers. comm. 1975)	**OXF**	Creag Mhor, v.c. 103	28		
ANTHEMIS arvensis L.	Kay (1971b)		Worm's Head, v.c. 41	18	9	2
	Kay (1971b)		Woodstock, v.c. 23	18		
	Kay (1971b)		Thetford, v.c. 28	18		
A. cotula L.	5085	**DHM, JKM**	A3054 W. of Newport, v.c. 10	18	9	2
	Kay (1971a)		Ardley, v.c. 23	18		
	Kay (1971a)		Perranuthno, v.c. 1	18		
	Kay (1971a)		Llanishen, v.c. 35	18		
	Kay (1971a)		Hilton, v.c. 40	18		
	Kay (1971a)		Moulsford, v.c. 22	18		
ARCTIUM lappa L.	Morton s.n.	**JKM**	Durnford, Amesbury, v.c. 8	36	9	4
A. minus Bernh. subsp. *minus*	5083	**JKM**	A3054 W. of Newport, v.c. 10	36	9	4
	Morton s.n.	**JKM**	Barnham Common, v.c. 26	36		
A. minus subsp. *nemorosum* (Lej.) Syme	4719	**JKM**	Cirencester, v.c. 33	36	9	4
A. minus subsp. *pubens* (Bab.) J. Arènes				—		
ARNOSERIS minima (L.) Schweigg. & Koerte	Maude (1940)		British, unlocalized	18	9	2
	Stebbins 3345 (Stebbins *et al.* 1953)	**UC**	Potterne, v.c. 7	18		
ARTEMISIA absinthium L.	5006	**JKM, WAT**	Birtley, v.c. 66	18	9	2
A. campestris L.				—		
A. maritima L. var. *maritima*	Morton s.n.	No voucher	Greatham, Teesmouth, v.c. 66	54	9	6
A. maritima var. *subgallica* Rouy				—		
A. norvegica Fr. var. *scotica* Hultén	4776	**DHM, JKM, S**	Cul Mor, v.c. 105	18	9	2
A. vulgaris L.	4713	**JKM**	Kew, v.c. 17 (wild)	16	8	2
ASTER linosyris (L.) Bernh.	4866	**JKM**	Durl Head, Brixham, v.c. 3	18	9	2
	C. D. Pigott (pers. comm. 1975)		Durl Head, Brixham, v.c. 3	18		
	C. D. Pigott (pers. comm. 1975)		Humphrey Head, Cartmel, v.c. 69	18		
A. tripolium L.	A. S. Gray (pers. comm. 1975)		12 localities in v.c. 28, 52, 54, 58, 60 and 111	18	9	2

A. tripolium var. *arcticum* Fries	Morton s.n.	No voucher	Lochmaddy, N. Uist, v.c. 110	18		
A. tripolium var. *discoideus* Reichenb. f.	Morton s.n.	No voucher	Waterford, v.c. H6	18		
BELLIS perennis L.	Maude (1939)[4]		British, unlocalized	18	9	2
	C. J. Marchant (pers. comm. 1975)		Teesdale, v.c. 66 (5 localities)	18		
	C. Brighton (in Stearn & Brighton (1969))		Kew, v.c. 17 (5 wild plants)	18		
BIDENS cernua L.	4843	**JKM**	Wokingham, v.c. 22	24	12	2
B. tripartita L.	4844	**DHM, JKM, WAT**	Wokingham, v.c. 22	48	12	4
CARDUUS acanthoides L.				—		
C. crispus L.	5018	**DHM, JKM**	Bollihope, Frosterley, v.c. 66	16	8	2
C. nutans L.	4734	**JKM**	Seaton Carew, v.c. 66	16	8	2
C. tenuiflorus Curt.	5102	**CAN, JKM, WAT**	Lydd, v.c. 15	54	9	6
CARLINA vulgaris L.	Morton s.n.	No voucher	Cirencester, v.c. 33	20	10	2
**CENTAUREA aspera* L.	Maude (1939)		British, unlocalized	22	11	2
**C. calcitrapa* L.				—		
C. cyanus L.				—		
**C. jacea* L.	Roy (1937)		Crowthorne, v.c. 22	44	11	4
C. nigra L.	S. M. Walters (in Elkington & Middlefell (1972))		Ardtornish, Morven, v.c. 97	22	11	2
	Elkington & Middlefell (1972)		Miller's Dale, v.c. 57	44		
	Elkington & Middlefell (1972)		Totley Bents, v.c. 57	44		
	Elkington & Middlefell (1972)		Stony Houghton, v.c. 57	44		
	Elkington & Middlefell (1972)		North Anston, v.c. 63	44		
C. nigra L. subsp. *nigra*	5097	**DHM, JKM**	Westgate in Weardale, v.c. 66	*c* 44	11	4
C. nigra L. subsp. *nigra* (eradiate plant)	Roy (1937)		Rendlestone, v.c. 3	44		
	Roy (1937)		Harbury Cutting, v.c. 38	44		
C. nigra L. subsp. *nigra* (radiate plant)	Roy (1937)		Devizes, v.c. 8	44		
C. nigra subsp. *nemoralis* (Jord.) Gugl.	5086	**JKM**	Apes Down, W. of Newport, v.c. 10	44	11	4
C. nigra subsp. *nemoralis* (Jord.) Gugl. (semi-radiate plant)	Roy (1937)		Burford, v.c. 23	44		
C. scabiosa L.	4977	**JKM**	Amesbury, v.c. 8	20	10	2
	Clapham (1962)		British, unlocalized	14, 20		
	Böcher & Larsen (1955)		Mullaghmore, v.c. H28	20		
	Roy (1937)		Devizes, v.c. 8	20		
	Roy (1937)		Erlestoke, v.c. 8	20		
	Frost (1958)		12 populations from southern and central England	20		
CHAMAEMELUM nobile (L.) All.	5076	**JKM**	Kynance Cove, v.c. 1	18	9	2
	4808	**JKM**	Cambridge, v.c. 29	18		

TABLE 1—*continued*

Name (* = alien)	Collection No.[1] or reference	Vouchers[2]	Origin	2*n*	Base No.	Ploidy level (*x*)
**CHRYSANTHEMUM segetum* L.	4745	**JKM**	Perth, v.c. 88	18	9	2
CICERBITA alpina (L.) Wallr.				—		
CICHORIUM intybus L.				—		
CIRSIUM acaule Scop.	4718	**JKM**	Cirencester, v.c. 33	34	17	2
	Pigott (1968)		England, unlocalized	34		
C. arvense (L.) Scop. var. *arvense*	Morton s.n.	**JKM**	Bishop Auckland, v.c. 66	34	17	2
**C. arvense* var. *incanum* (Fisch.) Ledeb.	Morton s.n.	**JKM**	Hull, v.c. 61	34		
C. dissectum (L.) Hill	4086	**JKM**	Port Ellen, Islay, v.c. 102	34	17	2
C. eriophorum (L.) Scop. subsp. *britannicum* Petrak	4716	**JKM**	Cirencester, v.c. 33	34	17	2
C. heterophyllum (L.) Hill	4729	**JKM**	Westgate in Weardale, v.c. 66	34	17	2
C. palustre (L.) Scop.	4741	**JKM**	Westgate in Weardale, v.c. 66	34	17	2
C. tuberosum (L.) All.	5095	**JKM**	Avebury, v.c. 7	34	17	2
C. vulgare (Savi) Ten.	Morton s.n.	**JKM**	Bowes, Barnard Castle, v.c. 65	68	17	4
CREPIS biennis L.	4942 = 5015	**DHM, JKM**	Staines, v.c. 21	40	10	4
	Edmonds *et al.* (1974)		Fen Ditton Lane, v.c. 29	31, 36		
	Edmonds *et al.* (1974)		Fen Ditton Lane, v.c. 29	39, 40		
	Edmonds *et al.* (1974)		Lord's Bridge, v.c. 29	40		
C. capillaris (L.) Wallr. var. *capillaris*	Morton s.n.	**JKM**	Crowthorne, v.c. 22	6	3	2
	Edmonds *et al.* (1974)		Hauxton Mile Bridge, v.c. 29	6		
	Edmonds *et al.* (1974)		Cambridge Airport, v.c. 29	6		
	Edmonds *et al.* (1974)		Lakenheath Warren, v.c. 26	6		
	Edmonds *et al.* (1974)		Harlton, v.c. 29	6		
	J. S. Parker (pers. comm. 1975)		Loch Garten, v.c. 96	6		
	J. S. Parker (pers. comm. 1975)		Cumnor, v.c. 22	6		
C. capillaris var. *glandulosa* Druce	4775	**JKM**	W. of Inverness, v.c. 96	6		
C. foetida L.				—		
C. mollis (Jacq.) Aschers.	4820	**JKM**	High Force, Upper Teesdale, v.c. 66	12	3	4
C. paludosa (L.) Moench	4731	**DHM, JKM**	Westgate in Weardale, v.c. 66	12	3	4
**C. setosa* Haller f.	4985	**JKM**	Braunton Burrows, v.c. 4	8	4	2
**C. vesicaria* subsp. *taraxacifolia* (Thuill.) Thell.	4732	**JKM**	Bishop Middleham, v.c. 66	8	4	2
	Edmonds *et al.* (1974)		Cambridge, v.c. 29	8		
	Edmonds *et al.* (1974)		Chesterton, v.c. 29	8		
	Edmonds *et al.* (1974)		Hauxton Mile Bridge, v.c. 29	8		
	P. E. Brandham (pers. comm. 1975) 64/1038	**K**	Kew, v.c. 17 (wild)	8		

	J. S. Parker (pers. comm. 1975)		Ongar, v.c. 18	8		
	T. G. Tutin (pers. comm. 1975)		Knighton, Leicester, v.c. 55	8		
ERIGERON acer L.	Rutland (1941)		British, unlocalized	18	9	2
E. borealis (Vierh.) Simmons	Morton s.n.	No voucher	Ben Lawers, v.c. 88	18	9	2
EUPATORIUM cannabinum L.	4800	**JKM**	Waldridge Fell, v.c. 66	20	10	2
FILAGO lutescens Jord.				—		
F. minima (Sm.) Pers.				—		
F. pyramidata L.				—		
F. vulgaris Lam.	4967	**DHM, JKM**	Saunton to Croyde, v.c. 4	28	7	4
	4687	**JKM**	Bishop Middleham, v.c. 66	28		
**GALINSOGA ciliata* (Raf.) Blake	Haskell & Marks (1952)		Claygate, v.c. 17	32	8	4
**G. parviflora* Cav.	Haskell & Marks (1952)		Bayfordbury, v.c. 20	16	8	2
GNAPHALIUM luteoalbum L.				—		
G. norvegicum Gunn.				—		
G. supinum L.	Rutland (1941)		British, unlocalized	28	7	4
G. sylvaticum L.	4766	**DHM, JKM**	Strath Rory, v.c. 106	56	7	8
G. uliginosum L.				—		
HYPOCHOERIS glabra L.	4955	**JKM**	Braunton Burrows, v.c. 4	10	5	2
	J. S. Parker (pers. comm. 1975)		Barton Mills, v.c. 26	10		
	J. S. Parker (pers. comm. 1975)		Thetford and Blakeney Point, v.c. 28	10		
H. maculata L.	Morton s.n.	**JKM**	Lizard, v.c. 1	10	5	2
	J. S. Parker (pers. comm. 1975)		7 localities in England	10		
H. radicata L.	4736	**JKM**	Seaton Carew, v.c. 66	8	4	2
	4862	**JKM**	Studland, Swanage, v.c. 9	8		
	J. S. Parker (pers. comm. 1975)		10 localities in Britain	8		
INULA conyza DC.	4725	**JKM**	Wotton-under-Edge, v.c. 34	32	8	4
I. crithmoides L.	Rutland (1941)		British, unlocalized	18	9	2
**I. helenium* L.	Rutland (1941)		British, unlocalized	20	10	2
I. salicina L.	Morton s.n.	No voucher	Lough Derg, v.c. H10	16	8	2
LACTUCA saligna L.				—		
L. serriola L.	2599	**JKM**	Holborn, London, v.c. 21	18	9	2
	Edmonds *et al.* (1974)		Cherry Hinton, v.c. 29	18		
L. virosa L.	2535	**JKM**	West Malling, v.c. 16	18	9	2
LAPSANA communis L.	Clapham (1962)		British, unlocalized	12		
	4730	**DHM, JKM**	Westgate in Weardale, v.c. 66	14	7	2
	Edmonds *et al.* (1974)		Cambridge, v.c. 29	14		
L. intermedia M. Bieb.	Burtt (1950)		Totternhoe, v.c. 30	14	7	2
LEONTODON autumnalis L.	Edmonds *et al.* (1974)		Grimes Graves, v.c. 28	12	6	2
	Elliot (1950)		British[3]	12		
	Finch (1967)		Many British localities	12		

TABLE 1—*continued*

Name (* = alien)	Collection No.[1] or reference	Vouchers[2]	Origin	2*n*	Base No.	Ploidy level (*x*)
LEONTODON autumnalis var. *pratensis* (Link) Koch	4743	**JKM**	Glen Doll, Clova, v.c. 90	12		
	5060, 5061	**JKM**	Lochnagar, v.c. 92	12		
L. hispidus L.	Elliot (1950)		British[3]	14	7	2
	Edmonds *et al.* (1974)		Grimes Graves, v.c. 28	14		
	Finch (1967)		Many localities in England	14		
	Finch (pers. comm. 1975)		White Horse Hill, v.c. 22	21	7	3
L. taraxacoides (Vill.) Mérat	Elliot (1950)		British[3]	8	4	2
	4818	**JKM**	Tytherington, v.c. 34	8		
	Edmonds *et al.* (1974)		Lakenheath Warren, v.c. 26	8		
	Finch (1967)		Many localities in England and Wales	8		
	Finch (pers. comm. 1975)		Fairlight Quarry and Telham, v.c. 14	12	4	3
LEUCANTHEMUM vulgare Lam. (dwarf ecotype)	Morton s.n.	**JKM**	Kynance Cove, v.c. 1	18	9	2
L. vulgare Lam.	Böcher & Larsen (1957)		Scraw Bog, v.c. H21 or 22	18		
	Böcher & Larsen (1957)		Edenderry, v.c. H18	18		
	A. J. C. Malloch (pers. comm. 1975)	**CGE**	3 localities in v.c. 20 and 29	18		
	Pearson (1967)		18 localities in v.c. 1, 2, 45, 48, 49, 51, 64 and 66	18		
	A. J. C. Malloch (pers. comm. 1975)	**CGE**	7 localities in v.c. 29, 63, 76 and 98	36	9	4
	Morton s.n.	**DHM, JKM**	Hazeley Heath, v.c. 12	36		
	Pearson (1967)		29 widely spread localities in British Isles	36		
**MATRICARIA matricarioides* (Less.) Porter	Rutland (1941)		British, unlocalized	18	9	2
M. recutita L.	5016	**DHM, JKM**	Englefield Green, v.c. 17	18	9	2
	Maude (1940)		British, unlocalized	18		
MYCELIS muralis (L.) Dum.	4794	**JKM**	Marlow, v.c. 24	18	9	2
	Edmonds *et al.* (1974)		Cambridge, v.c. 29	18		
	Edmonds *et al.* (1974)		Princes Risborough, v.c. 24	18		
	J. S. Parker (pers. comm. 1975)		Barnard Castle, v.c. 66	18		
**ONOPORDUM acanthium* L.	4970	**JKM**	Saunton to Croyde, v.c. 4	34	17	2

OTANTHUS maritimus (L.) Hoffmans. & Link	Rutland (1941)		British, unlocalized	18	9	2
**PETASITES fragrans* (Vill.) C. Presl	Maude (1940)		British, unlocalized	52	26	2
**P. fragrans* (Vill.) C. Presl (♂)	Sørensen & Christiansen (1964)		Wales	*c* 60	30	2
P. hybridus (L.) Gaertn., Mey. & Scherb. (♂)	4740	**JKM**	Westgate in Weardale, v.c. 66	*c* 60	30	2
PICRIS echioides L.	Clapham (1962)		British, unlocalized	10	5	2
	Morton s.n.	**DHM, JKM**	Steyning, v.c. 13	10		
	Edmonds *et al.* (1974)		Harlton Wheatsheaf to Lord's Bridge, v.c. 29	10		
	J. S. Parker (pers. comm. 1975)		Brentwood and Tollesbury, v.c. 19	10		
P. hieracioides L.	4722	**JKM**	Wotton-under-Edge, v.c. 34	10	5	2
	J. S. Parker (pers. comm. 1975)		Ongar, v.c. 18	10		
PULICARIA dysenterica (L.) Bernh.	Morton s.n.	**JKM**	Seaton Carew, v.c. 66	18	9	2
P. vulgaris Gaertn.	5080	**JKM**	Brockenhurst, v.c. 11	18	9	2
SAUSSUREA alpina (L.) DC.	4754	**JKM**	Clova, v.c. 90	54	9	6
SCORZONERA humilis L.	4863	**JKM**	Stoborough, v.c. 9	14	7	2
SENECIO aquaticus Hill	4801	**JKM**	Chester-le-Street, v.c. 66	*c* 40	10	4
S. cambrensis Rosser	Rosser (1955)		Frith, v.c. 51	60	10	6
S. erucifolius L.	4720	**JKM**	Ingleston Common, Hawkesbury, v.c. 34	40	10	4
S. integrifolius (L.) Clairv.	Rutland (1941)		British, unlocalized	48	12	4
S. jacobaea L.	Morton s.n.	**JKM**	Bowes, Barnard Castle, v.c. 65	40	10	4
	Böcher & Larsen (1955)		Kincasslegh, v.c. H35	32		
	Böcher & Larsen (1955)		Lady's Island Lake, v.c. H12	40		
	Böcher & Larsen (1955)		Skull Harbour, v.c. H3	40		
	Böcher & Larsen (1955)		Ben of Fore, Westmeath, v.c. H23	40		
S. paludosus L.				—		
S. palustris (L.) Hook.				—		
**S. squalidus* L.	Clapham (1962)		British, unlocalized	20	10	2
	4711	**JKM**	Kew, v.c. 17 (wild)	20		
S. sylvaticus L.	4899	**JKM**	Harbledown, Canterbury, v.c. 15	40	10	4
S. viscosus L.	5013	**DHM, JKM**	Edinburgh, v.c. 83	40	10	4
S. vulgaris L.	Clapham (1962)		British, unlocalized	40	10	4
S. vulgaris L. (radiate & eradiate plants)	4827	**DHM, JKM**	Pirbright, v.c. 17	40		
SERRATULA tinctoria L.	3919	**JKM**	Winch Bridge, v.c. 66	22	11	2
	Maude (1940)		British, unlocalized	22		
S. tinctoria L. (dwarf maritime ecotype)	Morton s.n.	**JKM**	Marsden, v.c. 66	22		

TABLE 1—*continued*

Name (* = alien)	Collection No.[1] or reference	Vouchers[2]	Origin	2*n*	Base No.	Ploidy level (*x*)
SOLIDAGO virgaurea L.	p801	**JKM**	Tetbury, v.c. 34	18	9	2
S. virgaurea L. (dwarf maritime ecotype)	2241	**JKM**	Kynance Cove, v.c. 1	18		
S. virgaurea L.	3940	**JKM**	Strath Fillan, Tyndrum, v.c. 88	18		
	4267	**JKM**	Black Head, v.c. H9	18		
	4426	**DHM, JKM**	Exeter, v.c. 3	18		
	4448	**DHM, JKM**	The Sneap, Muggleswick, v.c. 67	18		
	4540	**JKM**	Falcon Clints, Upper Teesdale, v.c. 66	*c* 18		
	4550	**JKM**	Avon Gorge, Bristol, v.c. 34	18		
	4563	**DHM, JKM**	Cheddar Gorge, v.c. 6	18		
	4564	**JKM**	Cheddar Gorge, v.c. 6	18		
	4595	**DHM, JKM**	Penzance, v.c. 1	18		
S. virgaurea L. var. *cambrica* (Huds.) Sm.	3945	**JKM**	Ben Nevis, v.c. 97	18		
	4248	**JKM**	Malin Head, v.c. H34	18		
	4535 to 4539	**JKM**	Winch Bridge, v.c. 66	18		
	4656	**JKM**	Beinn na Caillich, Islay, v.c. 102	18		
S. virgaurea L. intermediate between vars. *virgaurea* & *cambrica*	3144	**JKM**	The Castle, Rhum, v.c. 104	18		
	3228	**JKM**	Toe Head, S. Harris, v.c. 110	18		
SONCHUS arvensis L.	4819	**JKM**	Doncaster, v.c. 63	54	9	6
	Edmonds *et al.* (1974)		Shingay, v.c. 29	54		
	Curran (1968, 1969)		Rathcoole, v.c. H20	54		
	K. Jones (pers. comm. 1975)		Hythe, v.c. 11	54		
S. asper (L.) Hill	Edmonds *et al.* (1974)		Ely, v.c. 29	18	9	2
	Edmonds *et al.* (1974)		Shingay, v.c. 29	18		
	Curran (1968, 1969)		Celbridge, v.c. H19	18		
	Rutland (1941)		British, unlocalized	18		
	Barber (1941)		Merton, Wimbledon, v.c. 17	18		
	K. Jones (pers. comm. 1975)		Cheam, v.c. 17	*c* 18		
	K. Jones (pers. comm. 1975)		Kew, v.c. 17 (wild)	18		
S. oleraceus L.	Rutland (1941)		British, unlocalized	32	8	4
	Edmonds *et al.* (1974)		Cambridge, v.c. 29	32		
	Edmonds *et al.* (1974)		Lord's Bridge, v.c. 29	32		
	Curran (1968, 1969)		Calbridge, v.c. H19	32		
	Barber (1941)		Merton, Wimbledon, v.c. 17	32		

S. palustris L.	5099	**JKM, WAT**	Rochester, v.c. 15	18	9	2
**TANACETUM parthenium* (L.) Schultz Bip.	4739	**DHM, JKM**	Westgate in Weardale, v.c. 66	18	9	2
**T. vulgare* L.	Rutland (1941)		British, unlocalized	18	9	2
TRAGOPOGON porrifolius L.	Edmonds *et al.* (1974)		Diggings, v.c. 29	12	6	2
T. pratensis L. subsp. *pratensis*				—		
T. pratensis subsp. *minor* (Mill.) Wahlenb.	4738	**JKM**	Seaton Carew, v.c. 66	12	6	2
	Edmonds *et al.* (1974)		Grimes Graves, v.c. 28	12		
	Barling (1955)		Cirencester and area, v.c. 33 and 34 (*c* 200 plants)	12		
	Morton s.n.	**JKM**	Mickleham, Dorking, v.c. 17	12		
	J. S. Parker (pers. comm. 1975)		Docking, v.c. 28	12		
TRIPLEUROSPERMUM maritimum (L.) Koch subsp. *maritimum* var. *maritimum*	5069	**DHM, JKM**	Land's End, v.c. 1	18	9	2
	Kay (1972)		Many British localities	18 (0–2B)		
T. maritimum subsp. *maritimum* var. *phaeocephalum* (Rupr.) Hyl.				—		
T. maritimum subsp. *inodorum* (L.) Hyl. ex Vaarama var. *inodorum*	4809, 4810	**JKM**	Doncaster, v.c. 63	18	9	2
	Kay (1969, 1972)		Many British localities	18		
	Kay (1969)		Ardley, v.c. 23	36	9	4
T. maritimum subsp. *inodorum* var. *salinum* (Wallr.) Clapham				—		
TUSSILAGO farfara L.	Morton s.n.	No voucher	Birtley, v.c. 66	*c* 60	30	2

[1] Collection numbers refer to those of J. K. Morton unless otherwise stated.

[2] Abbreviations for herbaria are as given in Holmgren & Keuken (1974), except **WAT**, which refers to herb. University of Waterloo, Ontario, Canada; and **JKM**, to herb. J. K. Morton.

[3] Elliot (1950) gives no locality, but her material came from the south-eastern part of v.c. 67—Newcastle upon Tyne, Tynemouth and Seaton Sluice.

[4] The count is attributed to Dr K. B. Blackburn but the reference is incorrect. Tischler (1935, 1937, 1950) also cited Blackburn, but did not include the reference. I have been unable to trace a relevant publication of Blackburn.

DISCUSSION

CHROMOSOME NUMBERS AND TAXONOMY

Most of the chromosome numbers reported in this account confirm those already reported for the same species in other parts of their range. The only species whose chromosome numbers were previously unreported are *Cirsium dissectum* and *C. tuberosum*. Those of several varieties also appear to be new, viz. *Antennaria dioica* var. *hyperborea*, *Aster tripolium* var. *arcticum*, *Cirsium arvense* var. *incanum*, *Crepis capillaris* var. *glandulosa*, *Leontodon autumnalis* var. *pratensis* and *Solidago virgaurea* var. *cambrica*. In addition, chromosome numbers for 53 of the taxa are here reported for the first time from material from the British Isles. Most of these counts call for no comment, but the following are worthy of note:

Aster tripolium var. *arcticum* Fries. This is a dwarf northern variant not recognized in most British Floras. It occurs in salt-marshes on several of the Hebridean islands (Heslop-Harrison *et al.* 1946, 1951). It grows from 5 to 15 cm high and bears only a few capitula, which are of full size. Material transplanted from North Uist to a garden in northern England grew well for several years and retained its dwarf habit.

Leucanthemum vulgare Lam. The material from Kynance Cove was of a dwarf maritime ecotype about 10–15 cm high growing in the short turf near the top of the wind-swept cliffs. It retained its dwarf habit in cultivation.

Senecio vulgaris L. Seed from radiate plants found on a cindery roadside near Pirbright produced plants both with and without conspicuous ray florets. All had $2n = 40$. The radiate plant is referable to var. *hibernicus* Syme on the basis of Allen's (1967) account of variation in this species. However, Crisp & Jones (1970) and others have suggested that var. *hibernicus* may represent stages of introgression between *S. vulgaris* and *S. squalidus*.

Serratula tinctoria L. The small population growing on the steep, grassy slopes atop the magnesian limestone cliffs at Marsden consists of a distinctive maritime ecotype of shorter, more stocky habit with larger capitula in compact inflorescences. In cultivation it made an attractive rock-garden plant and retained its characters, though after several years it increased in stature from about 30 cm to nearer 40 cm.

Solidago virgaurea L. This is a very variable species found in a wide range of habitats. Over a period of many years I kept plants showing much of this variation under observation in cultivation in a garden in northern England. These observations demonstrated that material of this species from the British Isles behaves in a very similar manner to Continental material studied many years ago by Turesson (1925, 1930) and more recently by Björkman and co-workers (Björkman 1966, 1968; Holmgren 1968; Björkman *et al.* 1960). All this work indicates that in this species there is a wide range of genetically fixed variants, each closely adapted in physiology, phenology and morphology to particular habitats. Two major variational trends are recognizable; one of dwarf plants from open exposed habitats in the mountains, and the other of taller plants of woodland and heaths at lower elevations. The two differ in many ways though they are not wholly discrete and various intermediates are encountered. The differences are sufficient to warrant taxonomic recognition and, in view of the nature of this variation, subspecific status is appropriate. British botanists have for many years referred to the dwarf variant as var. *cambrica* (Huds.) Sm., but it is doubtful whether our material is different from that occurring on the Continent, where Wagenitz (1964) referred to it as subsp. *minuta* (L.) Arcangeli. However, Turesson (1925), in a discussion of the systematics of this variation, suggested that the Scandinavian material may not be the same as *S. minuta* L. from the Alps, but be referable to var. *alpestris* (Waldst. & Kit. ex Willd.) DC., which Hegi included in subsp. *minuta*. Pending a resolution of these nomenclatural and taxonomic problems it is probably better that we continue to refer to our material as var. *cambrica*, whilst recognizing that it may not be endemic to the British Isles.

Var. *cambrica* occurs in most of the mountainous areas of the British Isles—in Wales, the Pennines, the Lake District, mainland Scotland, the Hebrides and Ireland, where it also comes down to low altitudes on sea-cliffs. All the material that I grew retained its characters in cultivation. In cultivation var. *cambrica* flowers from mid June to the end of July, about 6 weeks earlier than the lowland variety—a difference which is also noticeable in the wild. Var. *cambrica* is characterized by its short, stocky habit, from 5 to 20 cm in height; its larger capitula, which range from 8 to 10 mm long in dried material; its compact, few-flowered inflorescences, in which the capitula are

borne more or less singly in a compact racemose arrangement on the main axis; its rounded, obtuse and spathulate basal leaves; and its bracts of the main axis, which are large and leaf-like. Usually the phyllaries are very narrowly lanceolate and sharply acute.

Var. *virgaurea*, though very variable, is characteristically a lowland species of open woodland, heaths and hedgebanks. In cultivation it flowered in August and September, with material from south-western England being several weeks later than the other material. It is characterized by its taller, less sturdy stature, from 60 to over 150 cm in height; its smaller capitula, 5 to 8 mm long, arranged in slender panicles or clustered in axillary branches along the tall, slender inflorescence; its acute, oblanceolate, petiolate basal leaves; and its small, narrow bracts or reduced leaves in the upper three-quarters of the stem. The phyllaries tend to be oblanceolate and more or less blunt in many, but not all, populations. Capitulum size tends to increase from south-western to northern districts. In the valleys of northern England and Scotland, populations combining the characters of the type variety and var. *cambrica* are sometimes encountered. That on the upper reaches of the River Tees is particularly well developed and extensive. A stunted ecotype occurs on the grassy slopes atop the sea-cliffs at Kynance Cove. Though compact, its other characters are those of the lowland variant. It retained its characters in cultivation though it increased in height from about 20 cm to 30 cm.

POLYPLOIDY

The spectrum of polyploidy for the Compositae native to the British Isles is as follows:

	Numbers of species	
Primary diploids		50
Triploids	2	
Tetraploids	22	
Hexaploids	6	41
Octoploids	1	
Secondary base numbers	10	
% polyploidy	44·6	

Only species and subspecies have been used in compiling these data, except where variants of a lower level have a different ploidy level. Three native genera (*Cirsium*, *Petasites* and *Tussilago*) have high base numbers which are almost certainly of secondary origin due to alloploidy, and these have been regarded as polyploids.

The incidence of polyploidy in the Compositae (44·6%) can be compared with that in other families for which fairly complete data from the British Isles are available—41·2% in the Caryophyllaceae (Blackburn & Morton 1957) and 69·8% in the Labiatae (Morton 1973). There appears to be no particularly convincing reason for the lower incidence of polyploidy in the Caryophyllaceae and Compositae than in the Labiatae, though the reason may in part be associated with the predominance of vigorous, vegetatively reproducing rhizomes in the Labiatae, a mode of reproduction occurring much less frequently in the other two families.

ACKNOWLEDGMENTS

I am very much indebted to Mr D. M. Cranston for information on previously published and unpublished chromosome counts; to the several workers who have permitted me to use their unpublished data (their names appear in Table 1); to Dr P. L. Pearson for permission to quote from his thesis; to Professor D. A. Webb, who many years ago supplied me with living material of *Inula salicina*; and to Miss J. M. Venn, who has assisted in preparing the data for publication. Completion of this work was facilitated by a fellowship from the Nuffield Foundation and an operating grant from the National Research Council of Canada.

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(*Accepted April* 1976)

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Botany of the lower Weaver valley, north Cheshire

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The River Weaver rises near the River Gowy on the eastern slopes of the Peckforton Hills in mid-west Cheshire. While the Gowy flows north and then, without much meandering, north-north-west to its confluence with the Mersey near Ellesmere Port, the Weaver follows a tortuous course east, south-east, north, and finally north-west to enter the Manchester Ship Canal below Weston Hill. Long before that canal was constructed, however, and while the Weaver still flowed into the Mersey, it was canalized downstream of Northwich, some sharp meanders were cut off and locks were constructed at Dutton; the tidal reaches were largely discarded in favour of a new canal from Sutton to the Runcorn docks at Weston Point.

This account is concerned with the five-mile stretch of the lower valley between the A56 (Warrington to Chester) and the A49 (Warrington to Whitchurch) road bridges. By absolute standards the natural history of this area might not seem outstanding but its value is enhanced in a region which some would like to see become a vast conurbation and where the density of population is already very high. Its conservation is therefore very desirable.

It is clear from the recent *Flora of Cheshire* (Newton 1971) that the plants of the Weaver valley form an important component of the county's flora. Earlier records are surprisingly scanty. It is evident that neither Lord de Tabley nor the collaborators in his *Flora* (de Tabley 1899) were very familiar with the valley, for they made no mention of *Equisetum sylvaticum*, *Galium odoratum*, *Lathraea squamaria*, *Thalictrum flavum* and *Phyllitis scolopendrium*. The reason is not far to seek, for, as de Tabley observed, woods and private estates were rigorously preserved for game.

John Harrison, a St Helen's miner, contributed numerous important first records for the area. Harrison who, according to de Tabley, 'was lost sight of in 1855' was self-taught, but, although de Tabley had reservations about his records of plants such as *Hypericum hirsutum* and *Lathyrus sylvestris*, these have since been substantiated. It is not unlikely that Harrison's origins helped him to gain access to the Aston Estate through the goodwill of the gamekeepers.

The Frodsham botanist, J. F. Robinson, contributed several interesting records from the then accessible parts of the valley. Though several of his records published elsewhere are demonstrably in error, there is no reason to doubt those accepted by de Tabley.

Although published in 1899, a few years after his death, de Tabley's manuscript was completed about 25 years earlier so that a century elapsed before a more detailed survey of the area was made. The present notes are derived from walks with Frank W. Clarke in the 1960s. These walks were recreational as well as exploratory and no attempt was made to check older records, of which we were then ignorant. Access was readily obtained and expressions of gratitude are due particularly to Mr Brian Talbot of Aston, Mr Ieuan Jones of Catten Hall and Mr S. Sproston of Belleair.

The north-eastern side of the lower Weaver valley lies in the parishes of Sutton, Aston and Dutton in the old Bucklow Hundred, and the opposite side in Frodsham, Kingsley and Acton in the old Eddisbury Hundred in 10 km square 33/5.7.

The uppermost solid formation is Keuper Marl, which lies against Keuper Waterstone outcrops of the Overton Fault by Frodsham Bridge. Underlying Triassic sandstones are exposed in those lateral wooded cloughs which have been more deeply incised. The region was affected by the four main glaciations and there are deposits of fluvioglacial gravel flanking the alluvial flood plain, and extensive but discontinuous deposits of sand and boulder clay on the higher land, which rises to about 50 m.

The river plain varies in width from about 200 to 800 m and includes fairly dry fields, damp summer pastures and two base-rich marshes below heavily flushed slopes. There are disposal grounds for dredged sludge near Frodsham and there is now an embanked lagoon for the same purposes below Crewood. In places the canalized river banks are somewhat above the sea-level

plain and some temporary flooding occurs in prolonged wet weather. A considerable amount of brine effluent enters the river from salt industries at Northwich and this salinity could account for the considerable inland extension of estuarine plants such as *Apium graveolens* and *Scirpus maritimus*. Before the Ship Canal was built, exceptionally high tides almost lapped Frodsham Main Street, and Mrs Bates, a centenarian who died only a few years ago, could remember such an event.

Woodland. Altogether there are about 30 woodland sites, including incised valleys, often heavily flushed within, wooded banks above the old river course and old plantations and parkland on more level ground around the former site of Aston Hall. The woods have been periodically thinned of the best timber and Big Wood was completely felled some years ago. As might be expected *Acer pseudoplatanus* predominates, with *Alnus glutinosa* in wetter situations, among *Betula pendula*, *Fraxinus excelsior*, *Sorbus aucuparia*, *Quercus robur* and *Ulmus glabra*. *Aesculus hippocastanum*, *Pinus sylvestris* and *Tilia* × *vulgaris* are evidently planted and there are a few fine specimens of *Fagus sylvatica*. The woodland contains well-grown *Crataegus monogyna*, *Ilex aquifolium* and *Prunus spinosa*. In the spring *Prunus avium*, which is not valued as timber, is a visual delight with *Malus sylvestris* and *Viburnum opulus*, the latter prevalent in the understorey with *Corylus avellana* and *Sambucus nigra*. A small group of *Tilia cordata* in a species-rich locality appears to be a relic of the ancient woodland.

If the trees are not in themselves remarkable they provide a canopy for a colourful herb layer which has all but disappeared in all the developed areas near by. Some of the main members are:

Athyrium filix-femina
Dryopteris filix-mas
Anemone nemorosa
Ranunculus ficaria
Cardamine amara
Silene dioica
Moehringia trinervia
Geranium robertianum
Oxalis acetosella
Geum urbanum
Chrysosplenium oppositifolium
Epilobium montanum
Circaea lutetiana
Conopodium majus
Mercurialis perennis
Lysimachia nemorum
Veronica montana
Lamiastrum galeobdolon
Glechoma hederacea
Ajuga reptans
Galium odoratum
Adoxa moschatellina
Lapsana communis
Endymion non-scriptus
Allium ursinum
Arum maculatum

Some species are scarcer than one might expect, e.g. *Carex sylvatica*, *Mycelis muralis*, *Myosotis sylvatica*, *Orchis mascula*, *Ranunculus auricomus* and *Sanicula europaea*.

However some specialities of the area are plentiful. They include *Campanula latifolia*, *Carex pendula*, *Equisetum telmateia* (often extensive at sand/marl junctions and up to four feet high), *Lathraea squamaria* (at six discrete stations extending, discontinuously, for 100 and 200 m in two localities, variously parasitic on *Ulmus glabra*, *Prunus avium* and *Corylus avellana*), *Milium effusum*, *Phyllitis scolopendrium* (in all the deeper, rock-exposed gulleys and abundant on the steep, friable slopes of two ravine woods), *Polystichum setiferum* (characteristic of six of the deeper cloughs usually near the preceding species).

Luzula pilosa and *Melica uniflora* are widespread but seldom in quantity on drained, untrodden fibrous-loam, and *Ribes nigrum*, *R. rubrum* and *R. uva-crispa* are scattered in congenial sites. *Luzula sylvatica* occurs on two, sand-topped woodland shoulders. Although *Convallaria majalis* is known to have been introduced in a pleasant dingle at Dutton, its presence also on glacial sand in another remoter place is puzzling unless somehow taken there by badgers which inhabit the bank. In two places *Polygonatum multiflorum* is clearly adventive from nearby woodland cottages but in so suitable an area it could once have been native.

Viola reichenbachiana is a frequent woodland border plant, especially on south-facing slopes, and opens well before *V. riviniana* in a normal spring.

The remaining woodland plants are rare in the region: *Carex laevigata* in one clough; *Dipsacus pilosus* below a flushed bank; and *Viola odorata* on a shaded bank rich in humus. Although *Carex strigosa* occurs in five sites its physical requirements seem to be exacting as it is found on unstable stream-side alluvium in the deeper gulleys where the water runs rapidly after heavy rain.

A narrow, small, wooded bank with bordering scrub on exposed calcareous red marl below

glacial sand is important as the only Cheshire station for *Lathyrus sylvestris*. This is clearly part of a relict community which includes *Adoxa moschatellina*, *Allium ursinum*, *Arum maculatum*, *Carex pendula* and *Melica uniflora* in the shade with *Ballota nigra*, *Clinopodium vulgare*, *Hypericum perforatum*, *Inula conyza*, *Linaria vulgaris*, *Rosa sherardii* and *Tragopogon pratensis* in the scrubby grassland. This appears to be the only natural site in the county for *Inula* and one of the few remaining sites for *Clinopodium*.

Water Meadows. Below Bradley Orchard *Carex acutiformis* and *Carex riparia* are plentiful in the perimeter ditches, with other plants which occur also in the main alluvial marshes below the wooded marl slopes of Beckett's Wood and Blackamoor. The marshes are important for the extensive zones of *Eleocharis uniglumis* and *Carex disticha* and contain a rich variety of plants at the various micro-levels from *Veronica beccabunga* in shallow runnels through *Veronica catenata* on summer-exposed mud to *Lysimachia nummularia* on flattened tussocks. Excluding common grasses and rushes, important members of the wetland association are:

Caltha palustris
Ranunculus trichophyllus
Cardamine pratensis
Lychnis flos-cuculi
Stellaria graminea
Filipendula ulmaria
Epilobium palustre
Apium nodiflorum
Polygonum hydropiper
Myosotis caespitosa
Scrophularia auriculata
Mentha aquatica
Valeriana officinalis
V. dioica
Senecio aquaticus
Triglochin palustris
Potamogeton pectinatus
Iris pseudacorus
Lemna gibba
Eleocharis palustris
Carex hirta
C. nigra
C. spicata
C. ovalis

The main site for *Dactylorhiza praetermissa* was in Crewood Marsh, now displaced by the sludge lagoon.

Brackish conditions occur in the old tidal reaches below Sutton Weir and Frodsham Lock, where *Phragmites australis* and *Scirpus maritimus* are abundant in the dykes, *Carex otrubae* is prolific on ditch-sides, and *Hordeum secalinum* is locally common in the old rank meadows.

These wetlands are regionally valuable since they are the last remnants of a formerly extensive zone which included the area between the sub-coastal reaches of the Gowy and the Weaver. This is now deeply dyked and maintained for farming by pumping stations on both eastern and western boundaries.

Other Habitats. The third main topographical feature of the valley are the contoured field-hummocks which are too steep or too short for ploughing. There is a complex structure of sand, clay and marl with frequent small flushed zones and spring-heads and a few leached areas. The following composite list, which excludes some very common species, embraces several plant associations of different micro-habitats:

Equisetum sylvaticum
Polygala vulgaris
Hypericum maculatum
Linum catharticum
Geranium dissectum
G. molle
Genista tinctoria
Lathyrus montanus
Potentilla anglica
Agrimonia eupatoria
Alchemilla filicaulis subsp. *vestita*
Primula veris
P. vulgaris
Anagallis tenella
Myosotis discolor
Veronica officinalis
Pedicularis sylvatica
Betonica officinalis
Teucrium scorodonia
Succisa pratensis
Solidago virgaurea
Dactylorhiza fuchsii
D. praetermissa
Scirpus setaceus
Carex pallescens
C. caryophyllea
C. echinata
Briza media

The low embankment bordering the river is popular with cattle and holds few plants of interest

except, at intervals, some species which appear to be characteristic of upper estuarine margins in this region, e.g. *Tanacetum vulgare*, *Conium maculatum*, *Dipsacus fullonum* and, in damper situations, a little *Thalictrum flavum*. There is a fine stand of *Carduus tenuiflorus* on an eroded sandy level. *Geranium pratense* grows plentifully in several fenced grassy corners and the summer leaves of a female colony of *Petasites hybridus*—a common species in the region—grow to a prodigious height at Pickering Lock.

The higher fields bordering the valley are grazed or cultivated. The few good ponds are probably mineral-rich and spring-fed and have a typical Cheshire pond association (Edmondson 1967), which includes *Berula erecta*, *Nymphaea alba*, *Oenanthe fistulosa* and *Typha angustifolia*, with *Pulicaria dysenterica* by the margins.

A *Salix-Alnus* swamp in a hollow below the Kingsley slopes is notable for *Carex paniculata* and *Scutellaria galericulata* and the now isolated meanders at Dutton have a varied flora which includes *Butomus umbellatus*, *Myosotis scorpioides*, *Rumex hydrolapathum* and *Polygonum amphibium*.

The verges of lanes and roads above the valley show an abundance of *Pimpinella major*, *Leontodon hispidus* and *Ononis spinosa*, with *Lonicera periclymenum* and *Tamus communis* prominent in the hedgerows.

In this district *Blackstonia perfoliata* is predominantly a plant of freshly exposed or constantly flushed, bare clay (Edmondson 1974). It is massed, with *Carex spicata*, on the creep ledges of a large clay slip at Dutton. Clay-pits soon acquire a colourful plant population but, given a suitable topography and associated moisture levels, a greater variety is achieved when localized leaching, weathering and humus accumulation has taken place. Some old Dutton pits, although now going over to scrub, still have a fascinatingly diverse association which, in addition to *Blackstonia perfoliata*, includes *Centaurium erythraea*, *Senecio erucifolius* and *Sieglingia decumbens*.

This broad account neglects the more critical groups but should mention a few interesting localized plants. *Hypericum hirsutum* grows on banks bordering an old pasture and *Malva moschata* similarly but on a lighter soil. There are vigorous thickets of the introduced *Polygonum sachalinense* in scrub near Crewood, *Cruciata laevipes* is surprisingly scarce, while *Sedum acre* has effectively invaded derelict boat hulks at Sutton Locks. Finally, the restriction of *Scirpus tabernaemontani*, in considerable quantity, to one flushed area suggests that it is associated there with saline springs.

Like John Harrison I grew up in a coal-mining district in south Lancashire where only the 'rosebay' temporarily brightens the spoil-heaps, and I can image his intense pleasure in visiting the lower Weaver valley. More than a hundred years later the contrast between the two districts is all the greater. Surrounded by everything that expands—industries, new towns and village dormitories—is it too much to hope that this valley, a microcosm of all that the local countryside used to be, will be spared the fate that befell south Lancashire in the days of the first economic revolution?

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(*Accepted April* 1976)

Artificial hybridization between *Quercus robur* L. and *Quercus petraea* (Matt.) Liebl.

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ABSTRACT

The results of attempted interspecific crossings between *Quercus robur* L. and *Quercus petraea* (Matt.) Liebl. are presented and compared with the results of selfed and intraspecific crosses. Only 22 fruits (acorns) were produced from 3,934 flowers pollinated in interspecific crosses. This success rate of 0·56% compares with those of intraspecific crosses of 43·6% (*Q. petraea*) and 51·4% (*Q. robur*) and selfed success rates of 40·2% (*Q. petraea*) and 19·3% (*Q. robur*). It is argued that large seed output over the long life of an individual tree, coupled with heterosis, could allow a relatively low success rate for interspecific crosses to produce a comparatively high percentage of hybrids and backcross derivatives. The acorns from intraspecific crosses were readily distinguished on shape, colour and longitudinal striping, whilst hybrid acorns were smaller and usually intermediate in respect of these characters, but with a comparatively wide range of variation.

INTRODUCTION

Morphological evidence for the existence of naturally occurring hybrids in Britain between *Quercus robur* L., the pedunculate oak, and *Q. petraea* (Matt.) Liebl., the sessile oak, has been presented by Carlisle & Brown (1965), Cousens (1963, 1965), Rushton (1974) and Wigston (1971, 1975). However, as Gottlieb (1972) observed, morphological data alone should not be considered sufficient to establish a case of hybridity. Supplementary evidence, such as an additive profile for biochemical characters (e.g. seed proteins) that are present in each parent but not in both, the fertility of intermediates, or the occurrence of suspected hybrids in intermediate habitats, is scanty in the case of *Q. robur* and *Q. petraea*, and attempts at producing the hybrid by artificial means have met with only limited success. Indeed, despite the large-scale populational surveys in Britain and in Europe, e.g. Becker (1972), only four authors have attempted to hybridize artificially *Q. robur* and *Q. petraea*. The accounts of Klotzsch (1854) and Geschwind (1876), which have been discussed by Dengler (1941), can both be disregarded since, although they recorded a modicum of success, their methods would probably not have met the carefully controlled conditions required of modern-day tree-breeding. Pyatnitski (1939, 1947, 1954) attempted an extensive breeding programme between many *Quercus* species but met with only marginal success. The attempts of Dengler (1941) appear to have been the most successful, since in one year 15% of *Q. robur* flowers pollinated by *Q. petraea* pollen produced fruits (acorns) compared with only 6% in the reciprocal cross. In other years his attempts were less rewarding, a level of between 0 and 2% being recorded.

Cousens (1965) and Gardiner (1971) have emphasized the need for more extensive crossing experiments between these two species. The present paper is concerned with the results of artificial hybridization between naturally occurring individuals of the two species, *Q. robur* and *Q. petraea*, in England.

SITES, MATERIALS AND METHODS

CROSSING EXPERIMENTS

Attempts to hybridize the species were carried out over three seasons—the first year, 1969, at Wyre Forest, v.c. 37, GR 32/745.762, and Uffmoor Wood, v.c. 37, GR 32/950.815, both near Birmingham, and during 1970 and 1971 at Hetchell Wood, v.c. 64, GR 44/438.443, and the surrounding small woodlands, near Leeds.

The methods employed were identical in all three years. During the previous growing season, trees of each species were identified and labelled. A hybrid index, based on 17 characters, was calculated (Rushton 1974) for each tree and only those trees scoring the median hybrid index representative of each species were used, i.e. extreme trees, whether they were indicative of hybridization or extreme for the species, were disregarded. In April the following year, pollination bags were attached to the terminal parts of branches at approximately 2 m from the ground. Each bag was 45 cm × 20 cm and had a transparent window to allow photosynthesis of trapped, expanding leaves to proceed normally. Bagging was completed before the buds had fully broken—a necessary

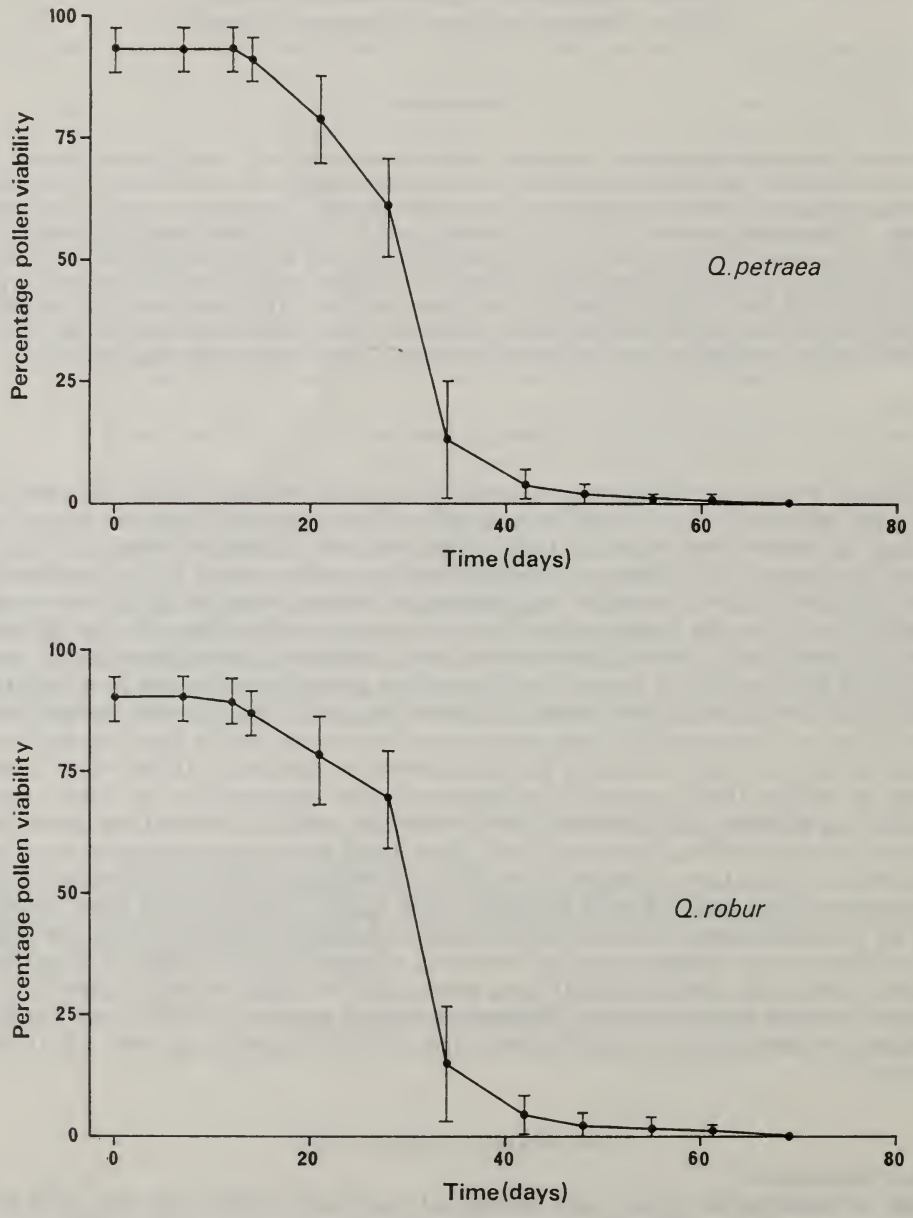

FIGURE 1. Loss of viability of stored pollen of *Q. petraea* and *Q. robur*. Pollen viability measured using nitroblue tetrazolium. Storage conditions: in open phials stood in closed sandwich boxes containing a layer of silica gel, the whole being kept at room temperature.

precaution, since in two of the three years *Quercus* pollen was detected on pollen traps around the experimental trees within three or four days after attaching the pollination bags. The bags were checked every day and emasculation carried out as the male catkins became exserted from the buds.

A preliminary study, in which pollen viability had been measured using nitroblue tetrazolium (Hauser & Morrison 1964), indicated that pollen of both species could be kept under low humidity and room temperature for a period of up to 14 days without any substantial loss of viability (Fig. 1).

Since there is great variation in the time of flowering of individual trees, it was necessary to devise a scheme that would allow for this. Consequently five branches on each tree were 'bagged'. As the trees came into flower, they were grouped in fours, two *Q. robur* and two *Q. petraea*. Large numbers of male catkins were harvested from each tree and pollen was collected from these in the laboratory by suspending them on nylon netting over petri dishes. The viability of this bulk collection of pollen was measured using nitroblue tetrazolium and any tree with an abnormally low count was rejected. Of the five bags on each tree, the female flowers of the first to mature were pollinated by pollen from the same tree, the flowers of the second by the other tree of the same species (i.e. an intraspecific cross), and the flowers of the third and fourth by the two trees of the other species in the group (i.e. interspecific crosses). The bag on the fifth branch was a control, being opened for the same time as the others but no pollination was attempted. Pollen was transferred using a camel-hair brush, the controls being 'pollinated' with a camel-hair brush but without pollen. No mature acorns were produced from these control bags.

Pyatnitski (1947) noted that the stigmatic surface of *Quercus* species has a short period of maximum receptiveness (up to six days), but that the female catkin remains receptive for a period of 10–14 days. The detection of a receptive stigma is difficult, but a glistening appearance of the stigmatic surface observed during development almost certainly indicates the commencement of the period of maximum receptiveness. The female flowers were pollinated as they became receptive and this was repeated every other day until nine days after the first pollination. At the time of pollination, the number of female flowers (5 to 48) in each bag was noted. This varied from 5 to 48. In all three years, no pollination was carried out before 27th April and none after 23rd May.

The pollination bags were left in place until mid-July, when all danger of contamination had passed; the bags also provided some protection during the early development of the acorns. The bags were replaced towards the middle of September, before the acorns had fully ripened, to protect them from foraging animals. The acorns were harvested, counted and recorded in mid-October. Vandalism throughout the three years of these experiments proved to be a major problem and accounted for the loss of about 15% of the pollination bags.

ACORN CHARACTERS

The production of a large number of acorns of known parentage provided an excellent opportunity to study acorn characters. Three characters were used to distinguish *Q. robur* and *Q. petraea* acorns —the presence of olive-green, longitudinal stripes on the outside of the mature, fresh acorn in *Q. robur* but absence from *Q. petraea*; colour, pale fawn in *Q. robur* but dark brown in *Q. petraea*; and shape, the *Q. robur* acorn being heavier, longer and thinner than that of *Q. petraea*.

Longitudinal striping, colour and shape were recorded on a random sample of the acorns produced from the artificial crosses. It was found possible to score the striping as well-developed, absent or intermediate and the colour as pale fawn, dark brown or intermediate. The shape was determined as the length:breadth ratio. The colour and striping characteristics of *Q. robur* were scored as 0, those of *Q. petraea* as 2, and intermediate states as 1.

RESULTS

CROSSING EXPERIMENTS

The results for the different types of crosses are given in Table 1. Differences are clearly evident between the success rates of different years—1970 appeared to be a relatively poor year for the production of acorns. Such annual variations between years are fairly common: Ovington & Murray (1964) noted a particularly poor year in 1961, preceded and followed by good years. Analysis of variance (Table 2) showed clearly that for every type of cross except selfed *Q. petraea* there was a significant difference between the results for different years.

TABLE 1. RESULTS OF SELFING, AND OF INTRA- AND INTERSPECIFIC CROSSES OF *Q. ROBUR* AND *Q. PETRAEA*

	1969			1970			1971			
	No. of flowers pollinated	No. of mature acorns obtained	% success rate	No. of flowers pollinated	No. of mature acorns obtained	% success rate	No. of flowers pollinated	No. of mature acorns obtained	% success rate	Mean % success rate
Selfed *Q. robur*	298	68	22·8	307	32	10·4	264	68	25·8	19·3
Selfed *Q. petraea*	392	186	47·5	215	57	26·5	297	120	40·4	40·2
Intraspecific *Q. robur* crosses	415	244	58·8	354	111	31·4	364	227	62·4	51·4
Intraspecific *Q. petraea* crosses	321	177	55·1	541	140	25·9	404	235	58·2	43·6
Q. petraea ♀ × *Q. robur* ♂	681	4	0·59	767	1	0·13	653	5	0·77	0·48
Q. robur ♀ × *Q. petraea* ♂	640	4	0·63	594	2	0·34	599	6	1·00	0·66

TABLE 2. ANALYSIS OF VARIANCE OF THE RESULTS OF SELFING, AND OF INTRA- AND INTERSPECIFIC CROSSES OF *Q. PETRAEA* AND *Q. ROBUR*: DIFFERENCES BETWEEN YEARS

		Degrees of freedom	Variance	Variance ratio	*P*
Selfed *Q. robur*	Between years	2	1,634·6	9·89	<0·001
	Within years	64	165·2		
Selfed *Q. petraea*	Between years	2	2,358·3	2·57	0·05–0·10 N.S.
	Within years	58	918·1		
Intraspecific *Q. robur* crosses	Between years	2	5,868·9	18·83	<0·001
	Within years	59	311·7		
Intraspecific *Q. petraea* crosses	Between years	2	7,967·3	24·24	<0·001
	Within years	65	328·7		
Q. petraea ♀× *Q. robur* ♂	Between years	2	5·08	13·37	<0·001
	Within years	146	0·38		
Q. robur ♀× *Q. petraea* ♂	Between years	2	5·71	10·20	<0·001
	Within years	151	0·56		

N.S. Not significant.

There are obvious differences between the different types of cross (Table 3). The results suggest that, although not self-sterile, the success rate of selfed *Q. robur* trees is significantly lower than that of intraspecific *Q. robur* crosses for all three years (Table 3). Generally, in such selfed *Q. robur* crosses, the success rate was about 35% of the corresponding intraspecific cross (Table 1). The same was not true for selfed *Q. petraea* and intraspecific *Q. petraea* crosses, although, in two years out of the three, the selfed crosses produced a lower success rate and in one year, 1971, this difference became significant (Table 3).

Generally, only rather low levels of success were obtained in the intraspecific crosses; with the exception of the poor year 1970, only about 50% of the flowers pollinated actually produced acorns. The probable reasons for this lie either with the pollination method or with some barrier between successful pollination and the production of the mature acorn. Although the detection of a 'receptive' stigma was difficult, it is felt that a more likely explanation lies in the abortion of maturing seed. Under natural conditions, rarely more than three acorns are ever produced on any one peduncle—this is particularly true of *Q. petraea*, where the short peduncle brings the acorns into close proximity with the stem and petioles, so that there is little space available for all the acorns to mature. In *Q. robur* the same is true, since the female flowers are clustered at the end of the peduncle. During pollination, many more than three flowers were commonly found on each peduncle, and it seems likely that factors have contributed to bring about the abortion of some

TABLE 3. ANALYSIS OF VARIANCE OF THE RESULTS OF SELFING, AND OF INTRA- AND INTERSPECIFIC CROSSES OF *Q. PETRAEA* AND *Q. ROBUR*: DIFFERENCES BETWEEN TREATMENTS

Analysis of variance between:	*P* 1969	1970	1971
Q. petraea selfed and *Q. robur* selfed	<0·001	0·10–0·25 N.S.	<0·001
Q. petraea selfed and *Q. petraea* intraspecific crosses	0·05–0·10 N.S.	0·10–0·25 N.S.	<0·001
Q. robur selfed and *Q. robur* intraspecific crosses	<0·001	<0·001	<0·001
Q. petraea intraspecific crosses and *Q. robur* intraspecific crosses	0·50–0·75 N.S.	0·10–0·25 N.S.	0·50–0·75 N.S.
Q. petraea as ♀ parent and *Q. robur* as ♀ parent in interspecific crosses	0·25–0·50 N.S.	<0·001	0·10–0·25 N.S.

N.S. Not significant.

maturing seeds. Frequently, it is possible to see immature acorns on peduncles at the end of the summer alongside fully mature acorns.

Crosses between the two species were singularly unsuccessful, the level of success being approximately 1% of that of intraspecific crosses (Table 1). Over the three years, 22 hybrid acorns were produced out of a total of 3,934 flowers pollinated, a success rate of 0·56%. *Q. robur* proved to be the more successful female parent in all three years, and was significantly better than *Q. petraea* in 1970 but not in 1969 and 1971 (Table 3). Such low levels of success are similar to those obtained by Dengler (1941) and Pyatnitski (1939, 1954).

Attempts were made to germinate some of the 22 hybrid acorns. Two acorns from 1969 were dissected in order to determine whether or not the embryo was fully formed. These acorns were lighter and smaller both in length and breadth than those derived from intraspecific crosses, but as far as could be determined, the embryo was fully developed and appeared normal. The remaining 20 acorns were sown in John Innes Compost No. 2, one per 8 cm diameter black polythene pot. No mature seedlings have been produced, but some degree of success was obtained.

Of these 20 acorns, five were infected by the fungus *Sclerotinia pseudotuberosa* (Rehm) Boud., which converts the whole of the acorn into a black sclerotium; three failed to show any signs whatsoever of germination; six produced a radicle but no further development took place; two produced an extensive root system, but no plumule emerged; two produced an extensive root system, but the seedlings died shortly after the plumule emerged; two produced weak seedlings, with fully emerged plumules, but these too died, one after 8 and the other after 14 weeks. The percentage of hybrid acorns infected by the fungus *S. pseudotuberosa* (nearly 25%) is very much higher than that of non-hybrid acorns. Acorns used for other experiments and collected from the same woodlands were also infected, but to a lesser degree (4%), suggesting that hybrid acorns may be more susceptible to attack by the fungus.

ACORN CHARACTERS

The results for acorn characters are presented in Table 4. Acorn shape, colour and striping differentiated the species very clearly but there were slight differences between selfed and intraspecific crosses within each species. This contrasts with population samples observed by Wigston (1971). He noted the colour and striping of naturally produced acorns in six woodlands. In both the *Q. petraea* and the *Q. robur* populations, he found that generally only 50% of the acorns were of the characteristic type; approximately 10% of the acorns resembled those of the other species, and the remaining 40% were intermediate. Jones (1959) regarded both colour and striping as useful characters in distinguishing the species and the results presented here agree closely with such an assertion. However, it must be remembered that the present results are from artificially produced acorns whilst Wigston's results were based on population samples. The hybrid acorns were generally intermediate for colour and striping, but showed a wide range of variation (Table 4).

The differences in acorn shape are consistent with published accounts and, since they are from controlled crossings, could probably be regarded as 'typical' of the species. However, Wigston's (1971) study showed that acorn shape had an anomalous distribution. In the *Q. petraea* woodland studied by him, the length:breadth ratio ranged from 1·0 to 1·4, whilst in the three *Q. robur* woodlands studied the ranges were 1·3–1·7, 1·0–1·3 and 1·0–1·4. Thus two of the *Q. robur* woodlands produced similarly shaped acorns to those of the *Q. petraea* woodland. Wigston's results were taken from natural populations and, moreover, since shape is a function of differential growth,

TABLE 4. MEANS AND STANDARD DEVIATIONS OF ACORN CHARACTERS OF ACORNS OF KNOWN ORIGIN. COLOUR AND STRIPING SCORED AS INDICES AS DESCRIBED IN TEXT

	Length:breadth ratio (shape)	Colour	Striping	Sample size
Selfed *Q. petraea*	1·49±0·19	1·94±0·17	1·94±0·08	76
Intraspecific *Q. petraea* crosses	1·36±0·26	1·96±0·13	1·86±0·10	144
Selfed *Q. robur*	1·71±0·12	0·44±0·24	0·39±0·43	67
Intraspecific *Q. robur* crosses	1·68±0·14	0·36±0·19	0·28±0·26	200
Interspecific crosses	1·57±0·25	0·95±0·43	0·74±0·71	22

their appearance is likely to be markedly influenced by external factors. Jones (1959) indicated that acorns produced in southern England are much larger than those produced in Scotland and Ireland, due possibly to the longer, warmer summers in the former. Geographical differences might, therefore, account for the differences between Wigston's (1971) results from populations in south-western England and those reported here.

The shape of the hybrid acorns fell midway between those of *Q. robur* and *Q. petraea*, but again it was very variable and overlapped considerably the ranges shown by the parent species. It should also be noted that the acorns were generally smaller than in either species.

DISCUSSION

The low success rates (0·5–1%) for artificially produced hybrids noted here and by other authors prompt the question whether or not they can create and maintain the high level of hybridity reported by Cousens (1962, 1963, 1965) and Wigston (1971). Jones (1959), for example, considered that the large numbers of intermediates recorded in natural populations were not of hybrid origin, but were 'mostly based on imperfect understanding of the specific characters'. Cousens (1963), in discussing the results of Dengler (1941) and Pyatnitski (1939, 1947), argued that since *Quercus* species show so much intraspecific morphological variation, any crossing plan should attempt to include all morphological types—those at the very extremes as well as those showing characters of the other species. Although an admirable suggestion, lack of manpower and resources prevented such an inevitably large crossing plan to be undertaken in the present investigation. Cousens (1963) also noted the importance of attempting backcrosses. This is an important point, since, once established in a population, an F_1 hybrid may produce a whole range of backcross progeny and, consequently, once the barriers to production of an F_1 hybrid are overcome, the rate of introgression depends mainly on the success of backcrosses. No information on this point is forthcoming from the researches presented here, since the exercise was solely to determine the success of interspecific crosses using trees of known morphological purity. However, it has already been shown (Rushton 1974) that trees of suspected second and third generation backcross status had a high level of pollen viability when compared with suspected F_1s and consequently the production of backcrosses might be relatively successful compared to the initial production of F_1 trees. One important point rarely stressed in hybridization studies within the genus *Quercus* is that, whilst large numbers of hybrid trees have been recorded, only a relatively small proportion of these could be regarded as F_1s, the others being probably backcross derivatives. Therefore, the question should be revised—can such a low success rate as recorded for artificially produced hybrids account for the frequency of apparent F_1 hybrids observed in nature?

It has to be remembered that individual trees of *Quercus* species are generally long-lived and consequently, as Stebbins (1950) has pointed out, although the success rate of production of hybrids may be fairly low, the long period over which they may be produced means that, in absolute terms, the number of hybrid acorns may be quite high. For example, Jones (1959) recorded that 120–140-year-old trees produced on average 50,000 acorns per year, and if only 0·1% of these were of hybrid origin, this would represent 50 acorns per tree per year for a substantial period of time. Under natural conditions, an oak woodland must receive large quantities of foreign pollen (Stebbins *et al.* 1947) and consequently the possibility of hybrid production must always exist.

Klotzsch (1854) reported heterosis in the F_1 hybrids, whilst in the present investigation it proved impossible to raise mature seedlings. However, Cousens (1965) argued that, since *Q. robur* is a very variable species, the degree of interfertility with *Q. petraea* might also be variable and might be dependent upon the parental genotypes. Gardiner (1970) has noted a comparable situation in *Betula pendula* Roth and *B. pubescens* Ehrh., where there is normally only a low interspecific crossing rate, but where certain trees of the two species will hybridize easily. Similarly, the degree of heterosis could also depend upon the parental genotypes and could account for the differences between previous work and the present study. If the hybrid were more vigorous than either parent, this might overcome some of the objections proposed by Jones (1959) to the existence of widespread hybridization among British oak species.

Obviously, such negative results as presented here cannot be used to support the hypothesis of widespread hybridization between *Q. robur* and *Q. petraea*. However, the successful production of

hybrid acorns, even though they were apparently inviable, together with the fact that only a limited range of material of each species was used, indicate that a wider survey, both in terms of the numbers of crosses attempted and the morphological types of the trees used, might produce comparatively large quantities of hybrid acorns.

ACKNOWLEDGMENTS

Mr A. S. Gardiner gave much advice in the early stages of this work and I am indebted to him for his help and interest. My thanks are also due to Dr M. C. Lewis for encouragement and stimulation during the progress of this work.

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(*Accepted May* 1976)

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A review of *Rubus* section *Discolores* P. J. Muell. in Britain

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ABSTRACT

Amendments to the British list of *Rubus* section *Discolores* P. J. Muell. are proposed and discussed. Three new species: **Rubus armipotens, R. rossensis** and **R. anglocandicans** are described and a revised list of the Section is given. Distribution maps of the new species are included.

INTRODUCTION

The taxonomy of *Rubus* section *Discolores* in Britain is greatly complicated by hybrids of the diploid, outbreeding *Rubus ulmifolius* Schott. These may be sterile or fertile, are usually robust and showy, and occur frequently as isolated clumps or individuals in areas where *R. ulmifolius* comes into contact with ancient bramble populations, especially in southern and western England and coastal South Wales. Such plants are frequently collected and named from Watson (1958), but, since very few British examples of the Section have been found to match syntypes of the original authors, it is likely that most of these identifications are erroneous. It appears necessary, therefore, to establish a reliable British list which may serve as a sounder basis for future observation and research. The twenty names discussed below are, with one exception, those included in this section by Dandy (1958); they were extracted from Watson's manuscripts which were posthumously published (Watson 1958).

DISCUSSION

1. *Rubus ulmifolius* Schott

Watson (1958) gave a satisfactory account of this species although the list of fertile hybrids could be amended and expanded not only for cases where the parentage is obvious but also where it is putative or uncertain. As it is a thermophilous species it avoids high ground in Wales, Scotland and northern England and, north of a Mersey–Trent line, is largely confined to the coasts as far as Ayr in the west and Montrose in the east.

2. *R. pseudobifrons* Sudre

The widespread and well-marked British species given this name by Watson (1958), and earlier (1928) referred to as *R. winteri* P. J. Muell., differs from the holotype of *R. pseudobifrons* Sudre (coll. *G. Genevier*, 28/6/1867, Mortagne, Vendee, France, as *R. discolor*, herb. P. J. Muell., no 1318 in **LAU**) in several respects, but notably in the shape and toothing of the terminal leaflet and in stem and panicle armature; it is therefore described below as a new species.

Rubus armipotens Barton ex A. Newton, **sp. nov.**

Robustus. Turio altiarcuatus in umbrosis fuscoviridis in apricis rufoviolaceus, pruinosus, capillis appressis dense obsitus, obtusangulus superficiebus planis vel concavis, striatis; aculeis crebris ad angulos dispositis longis, validis, plerumque patentibus, acute acuminatis e basi lata paullatim contractis instructus.

Folia 3- vel 5-nata atroviridia, margine undulata digitata vel subpedata quorum petioli aculeis falcatis nonnullis validis armata; foliola subimbricata superne ± glabra inferne grisea vel albe-

scentia tomentosa, pubescentia; foliolum terminale obovatum vel rhomboideum late acuminatum basi emarginata dentibus divaricatis mucronatis haud profundis.

Inflorescentia angusta ad apicem aphylla, ramuli superiores anguste, inferiores laxe adscendentes cymosi c 3-flori saepe inter se distantes; pedicelli breves.

Rachis vix flexuosa supra tomentosa praeterea pilosa, aculeis nonnullis rectis declinatis vel patentibus longis tenuibus obsita.

Sepala griseoalba tomentosa pubescentia interdum parum aculeolata, laxe reflexa. Petala suborbicularia pallide rosea margine capillata apice emarginata. Stamina alba stylos pallide luteos vix superantia. Carpella breviter pilosa.

Robust. Stem high-arching, greenish in shade to brownish or reddish-purple in sun, closely felted with appressed tufted and simple hairs, pruinose, blunt-angled with sides flat to slightly concave, striate; prickles on the angles fairly numerous, long, strong, quickly tapered to a slender sharp point from broad bases, usually patent, a few sometimes obfalcate, straight, slanting or with a falcate tip on the same plant.

Leaves 3- to 5-nate, dark green, with undulate margins, digitate or subpedate, petioles with a few rather large falcate prickles; leaflets usually subimbricate, ± glabrous above, grey to white felted (suppressed in shade) and pubescent beneath. Terminal leaflet constant in shape, ± narrowly obovate or rhomboid with wavy margins, broadly acuminate with usually shallow, open, divaricate, ± mucronate teeth, and emarginate base.

Panicle usually leafless at apex, composed of ± narrowly ascending cymose usually 3-flowered branches often spaced out giving a narrow ± equal appearance; pedicels short; lower branches laxly ascending from axils of ternate leaves; simple leaves rarely more than one; leaves white-felted and pilose beneath.

Rachis ± straight or slightly flexuous, felted and moderately pilose above with spreading hairs, armed with several long, straight, declining, slender prickles, sometimes deflexed at base.

Sepals greenish-white, felted, pubescent, smooth, sometimes minutely aculeolate, loosely reflexed. Petals suborbicular, very shortly clawed, pale pink, erose, ciliate on margins. White stamens ± equal to yellowish styles. Anthers glabrous; carpels shortly pilose.

HOLOTYPUS: Sibford Heath, v.c. 23, 17/8/1927, *H. J. Riddelsdell*, as *R. godroni*, nos 1883/5 herb. Barton & Riddelsdell (**BM**)

Numerous sheets of this species are scattered throughout the main British herbaria under a variety of names; early gatherings of open-ground specimens were attributed to one of the Continental 'discolorous' taxa current at the time, e.g. *R. discolor*, *R. thyrsoideus*, *R. robustus*, and shade-grown examples were called *R. rhamnifolius* or *R. villicaulis*. Identification with Continental taxa has always presented problems. Rogers (1900) included it under *R. argentatus* P. J. Muell. and later (1905), at Focke's instigation, adopted the name *R. godronii* Lec. & Lam. But in his MS notes in 1908 (**BM**) he admits 'our *godroni* is very aggregate and our *robustus* ill defined'. Many gatherings made by H. J. Riddelsdell in the 1920s now in **BM** were labelled *R. godronii* but later W. C. Barton, after working through Continental material in Focke's and Müller's herbaria without finding a match, labelled many of the sheets with the MS name *R. armipotens*, but left no description. This name is now taken up as a tribute to his extensive research into this critical group of brambles. The first British reference to *R. pseudobifrons* was by Watson (1929b), but he nowhere gave reasons for his choice. It is concluded that, as in many other cases, he was relying solely on the description in Sudre (1909) and misinterpreted it.

The known distribution of this species is shown in Fig. 1 and includes v.c. 7, 8, 11–19, 21–23, 27, 33, 35, 37–40, 42, 55, 62.

3. *R. chloocladus* W. C. R. Watson (*R. pubescens* Weihe ex Boenn., non Rafin.)

Watson's specimens from Clophill, v.c. 30 (**K**), the only recorded occurrence of this plant in Britain, while superficially similar to *R. chloocladus* differ substantially in details, such as stouter stem prickles, stem pilosity and shape of terminal leaflet, from herbarium specimens from Germany and collections I have made in Weihe's own district with H. E. Weber. *R. chloocladus* should therefore be excluded from the British list. The identity of Watson's specimens is not known.

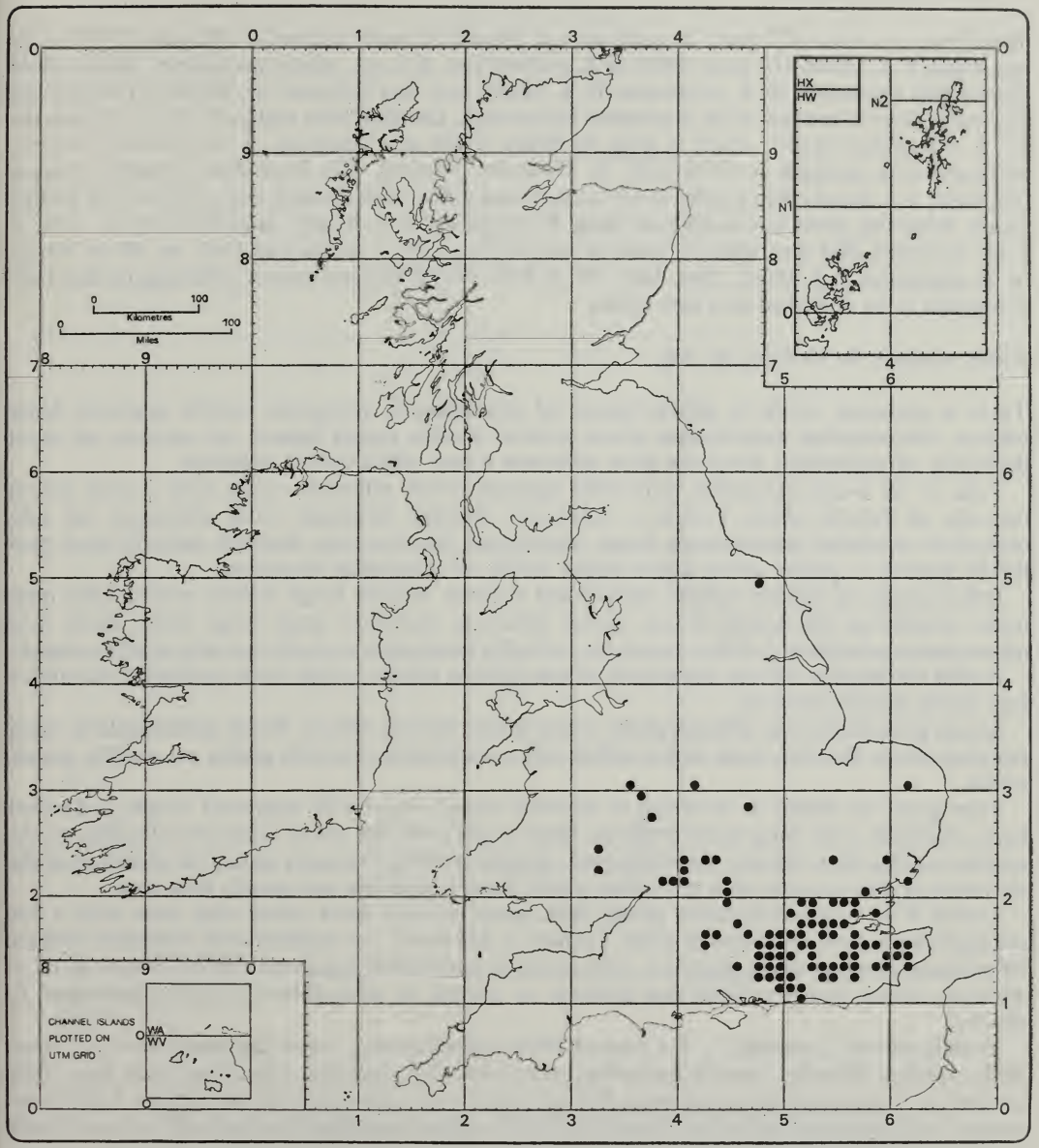

FIGURE 1. Distribution of *Rubus armipotens* Barton ex A. Newton in the British Isles.

4. *R. winteri* P. J. Muell. ex Focke

Syntypes of this taxon (incl. Wirtgen, Pl. Sel. Fl. Rhen. 1063, K) reveal a plant virtually identical with Set of British Rubi no 113 from Stydd, v.c. 57, issued as *R. argentatus* var. *robustus*, and some specimens collected by Bagnall and Bloxam and named *R. discolor* γ *macroacanthos* from Hartshill, v.c. 38. The same species occurs also in v.c. 36, 55 and 56, but many of Watson's determinations of specimens from other counties (**OXF, SLBI**) are incorrect and his description in Watson (1958) was widened to include some of these.

5. *R. crassifolius* Genev.

Specimens of a plant frequent in parts of v.c. 34 and 36 were referred by Rogers (1900) to *R. argentatus* P. J. Muell. and later (1905) to *R. godronii* Lec. & Lam., which has priority. Sudre (1904) determined specimens as *R. propinquus* P. J. Muell. and was followed by Watson (1958). Since this was a later homonym of *R. propinquus* Richardson, Dandy (1958) replaced it in the British list by *R. crassifolius* Genev., which is given by Sudre (1909) as a synonym. *R. crassifolius*, however, as revealed by syntypes in **CGE** (coll. G. Genevier, Evrunes, à la Rigandière, Vendée, France, 3/9/1866), is a densely hairy plant in all its parts and differs also in other respects from the British taxon. Since our plant is also different from *R. propinquus* P. J. Muell., as revealed by no. 1316 in **LAU** (syntype), and also from *R. godronii* Lec. & Lam. (Rub. praesertim Gall. no. 69 ex Nancy = *R. argentatus* P. J. Muell. (Bat. Eur. 332 in **BM**, **MANCH**)) and cannot otherwise be matched, it requires to be described as a new taxon.

Rubus rossensis A. Newton, **sp. nov.**

Turio in umbrosis viridis in apricis fuscus vel atrorufescens, pruinosus, capillis appressis dense obsitus, obtusangulus superficiebus planis striatis. Aculeis paucis falcatis vel curvatis vel rectis declinatis vel patentibus, nonnullis apice obfalcatis e basi valida exortis praeditus.

Folia 3- vel 5-nata subpedata atroviridia quorum petioli pilosiores quam turio aculeis paucis curvatis vel falcatis obsiti. Foliola ± imbricata; foliolum terminale ovale obovatum vel suborbiculare paullatim nonnunquam longe cuspidatum basi truncata dentibus crenatis haud profundis superne ± glaber subtus aspere pilosa viride- vel griseoalba tomentosa.

Inflorescentia ad apicem aphylla pyramidata superne bracteis longis trifidis inferne foliis nonnullis simplicibus vel 3-natis ornata ramuli inferiores multiflori saepe longi foliosi medii laxe adscendentes subcymosi 3–5 flori superiores pedicellis brevissimis aculeolis curvatis ornatis congesti.

Rachis vix flexuosa inferne tomentosa, pilosa superne villosa aculeis rectis (nonnullis curvatis) e basi media exortis instructa.

Sepala griseotomentosa albomarginata crasse pilosa inermia reflexa. Petala suborbicularia rosea margine pilosa. Stamina rosea stylos pallide roseos superantia. Carpella glabra vel capillis sparsis obsita.

Stem green (in shade) or brownish to maroon, closely felted with appressed simple and tufted hairs, also with a few long hairs, pruinose, blunt-angled with flat striate sides. Prickles few, on the angles, varying from falcate, slightly curved, straight sloping to exactly patent or obfalcate at the tip (more or less constant on a particular plant), from a stout but not usually long base.

Leaves 3- to 5-nate subpedate, glossy dark green, petioles more pilose than stem with a few strong-based curved or falcate prickles. Leaflets ± imbricate, the terminal oval, roundish-obovate or orbicular, long or short cuspidate, with entire or emarginate base, with shallow crenate teeth ± glabrous above, roughly pilose and greenish or greyish to white-felted beneath (suppressed in shade).

Panicle narrow pyramidal, ± flat topped, lower branches long, spreading, many-flowered, often leafy, median branches loosely ascending, subcymose 3–5 flowered, uppermost with very short pedicels giving a congested appearance. Pedicels short with a few small curved prickles. Uppermost quarter of panicle leafless but with long trifid bracts almost equalling branches, with several simple and ternate leaves below.

Rachis somewhat flexuous, felted, thickly pilose below, villose above with several mostly straight prickles (a few curved) tapering gradually from a moderate base. Panicle with a few minute glandular hairs up to 0·5 mm, particularly on the bracts and stipules.

Sepals grey-felted, with white margins, ± strongly pilose, unarmed, reflexed. Petals suborbicular, short-clawed, bright pink with strongly pilose margins. Stamens pink, longer than pinkish styles. Carpels glabrous or with a few longish hairs.

HOLOTYPUS: Hillside above Redbrook, v.c. 34, 11/8/1892, *A. Ley & W. M. Rogers*, as *R. argentatus* P. J. Muell., Set of British Rubi no. 30 (**MANCH**)

This bramble is particularly prominent in the vicinity of Ross and southward to the Forest of

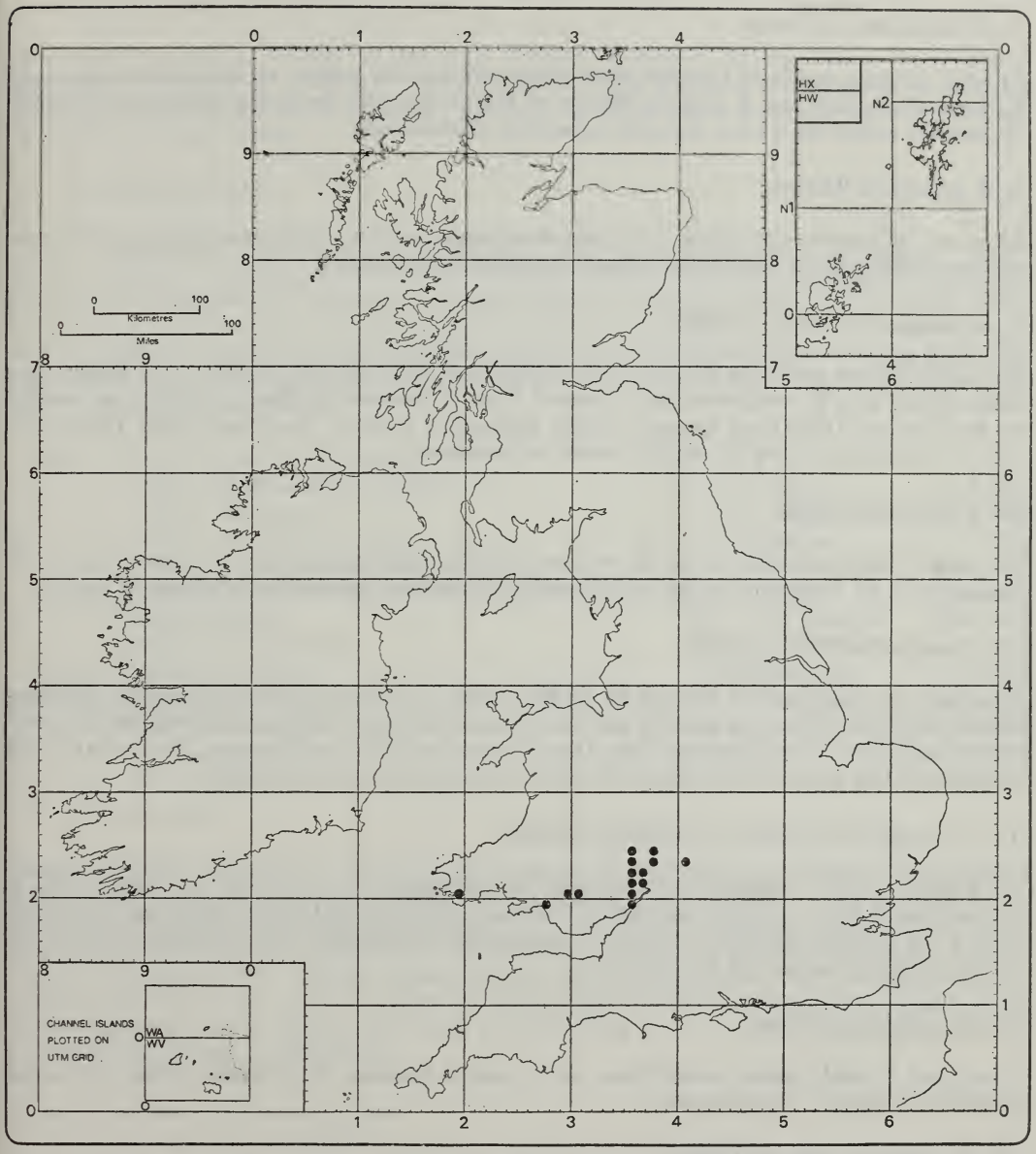

FIGURE 2. Distribution of *Rubus rossensis* A. Newton in the British Isles.

Dean, where it makes a fine show on wood margins with handsome rose-pink flowers and grey-white foliage. Some of the early gatherings received various names but, after Rogers' visit to the area in 1892, it became the principal component of his concept of *R. argentatus* and was later known as 'Herefordshire *godronii*'. A good series can be seen in herb. Barton & Riddelsdell (**BM**) nos. 648, 915, 4880/2–5, 4892/4, 8147/8 (isotypi).

The known distribution is shown in Fig. 2 and covers v.c. 33–37, 41, 45 (T. A. W. Davis no. 73/1359).

6. *R. lamburnensis* Rilstone

This Cornish plant is constant over a limited area and should be retained in the list as a species.

7. *R. carnkiefensis* Rilstone

Another constant but local Cornish plant whose affinities are rather, as the author states, with *R. dumnoniensis* Bab. and *R. ramosus* Bloxam ex Briggs than with the section *Discolores*. It should be included within the section *Sylvatici*, subsection *Discoloroides*.

8. *R. pydarensis* Rilstone

Rilstone (1952) finally placed this in the *Discolores* where, in view of its constancy over a wide area and its combination of characters, it should be retained as a species.

9. *R. stenopetalus* Muell. & Lefèv.

The single British gathering of this plant by Watson from Everleigh Ashes, v.c. 8 (**SLBI**), has some affinity with *R. armipotens* and is distinct from *R. stenopetalus* Muell. & Lefèv., as revealed by Bat. Eur. 342 (**BM**) (coll. Questier 7/1860, Buisson de Tillet nr Vaumoise, Valois, France, *loc. class.*). Its inclusion in the British list cannot be sustained.

10. *R. geniculatus* Kalt.

The single British specimen cited by Watson (1958) cannot be equated with gatherings of *R. geniculatus* Kalt. from the Aachen district, nor with any other named taxon known to me.

11. *R. cuspidifer* Muell. & Lefèv.

Specimens so determined by Watson (**K, SLBI**) cannot be matched with any named taxon known to me. They differ from one another and also from the holotype of *R. cuspidifer* Muell. & Lefèv. (coll. Lefèvre 26/7/1855, Forêt de Retz, Oise, France, herb. P. J. Müller no. 1387 in **LAU**). The inclusion of this species in the British list cannot, on this evidence, be justified.

12. *R. cornubiensis* (Rogers & Riddelsd.) Rilstone

As Rilstone (1950) suggested in his account, the association of this species by Watson with *R. bifrons* Vest ex Tratt., a widespread central European species which I have studied both in exsiccata and in the German Ardennes, cannot be maintained. The British species belongs rather in the section *Sylvatici*, subsection *Discoloroides*.

13. *R. tresidderi* Rilstone

This local Cornish species should also, as its author suggests, be included within the section *Sylvatici*, subsection *Discoloroides*.

14. *R. vulnificus* Lefèv. ex Genev.

Lefèvre's original gatherings, as revealed by specimens in herb. P. J. Müller (**LAU**), differ significantly from Watson's gatherings from v.c. 14 and determined as *R. vulnificus*. These represent a local unnamed taxon. *R. vulnificus* Lefèv. ex Genev. should be excluded from the British list.

15. *R. procerus* P. J. Muell.

This is widely planted as 'Himalayan Giant' in gardens and allotments and frequently persists when these are abandoned. It is also bird-sown and, being extremely vigorous, it is soon established in hedges and on waste ground. It is now widely naturalized and spreading in Britain, particularly on the outskirts of towns; any gathering of a bramble of section *Discolores* encountered in such habitats should first be checked for this.

16. *R.* × *polioclados* W. C. R. Wats.

This taxon was said by Watson (1929a) to be abundant in parts of Epping Forest, v.c. 18, and to have an affinity with *R. ulmifolius*. It exhibits considerable glandular development in stem and panicle and is best regarded as a hybrid between *R. ulmifolius* and a glandular species. It was not included in Watson (1958).

17. *R. neomalacus* Sudre

Sudre's autographed syntypes (coll. G. Genevier, 1858 & 1860, Torfou & St Hilaire, Vendée, France, herb. P. J. Müller, nos 1636/8–40, **LAU**) are indeed close to, if not identical with, some specimens so determined by Watson. The name should be retained provisionally for some Surrey and Hampshire gatherings, but care should be taken to distinguish it from *R. rubritinctus* and from *R. imbricatus*, and also from hybrid derivatives of *R. armipotens* which occur in the same area. I have collected examples from Bramshott Common, v.c. 12, and the following, from v.c. 17, can also be taken as representative:

BM	(herb. Barton & Riddelsdell)		
	6541 Wareham Hill, Witley	*W. M. Rogers*	4.8.1894
	6542 Haslemere	*W. M. Rogers*	20.8.1900
	6543 Ockham Common	*C. E. Britton*	8.1901
	6544 Farley Heath, Guildford	*W. C. R. Watson*	15.7.1930
CGE	Opposite Littleworth Common, NW side of A3	*W. H. Mills*	1.7.1953
	Milford Heath	*W. C. R. Watson*	30.6.1934
	Smithwood Common	*W. C. R. Watson*	14.7.1930
OXF	Witley (no. 2050)	*E. S. Marshall*	6.7.1897
SLBI	Thursley Common	*E. S. Marshall*	5.9.1891
	Fairmile Common	*C. E. Britton*	9.8.1902
	near Newlands Corner	*C. Avery*	7.7.1938

18. *R. falcatus* Kalt.

Despite extensive enquiries to various European herbaria, no authentic specimen of Kaltenbach's can be discovered. The specimen referred to by Watson (1958), collected by himself and N. D. Simpson at Neuenhof, near Forst, Aachen, no. 371137 in herb. Simpson (**BM**), appears to be *R. goniophylloides* Sudre, which I have seen myself in quantity in the Aachen district. Despite Watson's assertion of the identity of this with the 'Sandy (Beds) plant' there are significant disparities and, since I am unable to match the British species with exsiccata of any eligible taxon validly named on the Continent, nor could it be identified by H. E. Weber (pers. comm. 1974), it is here described as a new species.

R. anglocandicans A. Newton, **sp. nov.**

Turio altiarcuatus fuscorufescens ± fulgens subglaucescens ± glaber acutangulus superficiebus sulcatis. Aculeis ad angulos dispositis e basi lata paullatim contractis rectis declinatis vel patentibus vel curvatis vel falcatis nonnullis uncinatis praeditus.

Folia quinata subdigitata superne glaber inferne griseo- vel albo-tomentosa molliter pubescentia. Foliolum terminale late vel anguste obovatum vel ellipticum basi truncata longe acuminatum argute inciso-serratum.

Inflorescentia saepe elongata thyrsoidea ad apicem aphylla ramuli pedunculis brevibus cymosi, pedicellis sat longis, utrisque tenuibus aculeolis curvatis instructis.

Rachis vix flexuosa inferne glabrescens superne tomentosa pilosa aculeis validis uncinatis falcatisve e basi lata exortis obsitus.

Petala alba late elliptica ciliata; sepala viride- vel griseoalba tomentosa pubescentia reflexa. Stamina alba stylos virides parum superantia. Carpella capillis longis barbata.

Stem brownish-red, high-arching, ± shining, subglaucescent, ± glabrous, usually sharp-angled with grooved sides. Prickles few on the angles, gradually tapered from a broad base (quite wide for most of length), straight, slanting, curved, or falcate.

Leaves quinate, subdigitate, glabrous above, velvety pubescent and thickly grey to white-felted beneath. Terminal leaflet narrow to broad, obovate or elliptical, acuminate, with an entire base, coarsely and sharply serrate. Panicle often long, cylindrical, the branches mostly short-peduncled cymes, the pedicels rather long. Apex usually leafless but with broad bracts, not, or only slightly, trifid; lower portion with ternate, sometimes quinate, leaves, Peduncles and pedicels rather slender with curved pricklets.

Rachis straight or slightly flexuous, glabrescent below, felted and pilose above, with several, often stout, strongly falcate prickles; those below often shorter but all very broad-based.

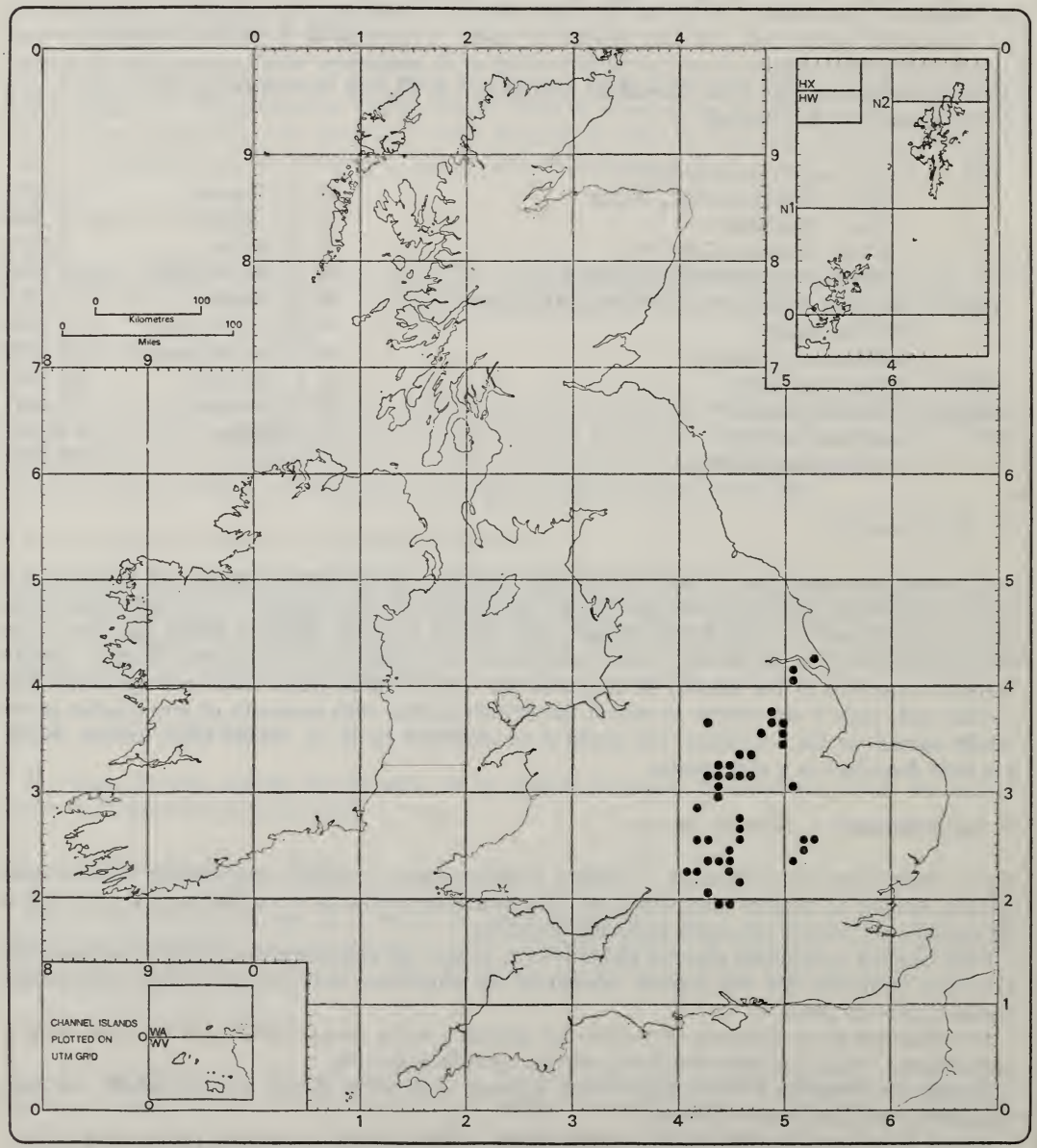

FIGURE 3. Distribution of *Rubus anglocandicans* A. Newton in the British Isles.

Petals white, broad, elliptical, ciliate. Sepals greenish to greyish-white, felted, ± acute or mucronate, reflexed. Stamens white, slightly exceeding the green styles. Carpels long-pilose, bearded.

HOLOTYPUS: Frilford Heath, v.c. 22, 21/8/1895, *W. M. Rogers*, as *R. thyrsoideus* sp. coll., Set of British Rubi no. 116 (**MANCH**) (Isotypi in **BM**, **CGE**, **OXF**)

This is the chief representative in Britain of the series *Candicantes*, which is widespread in areas of northern and central Europe where *R. ulmifolius* is absent. It is similar to *R. candicans* Weihe but differs in leaf-toothing, quality of armature, panicle outline and flower characters. It is also close to some specimens named *R. thyrsanthus* by Danish authors. A good series of specimens can be seen at **OXF**. It is noticeable that *R. anglocandicans* presents a 'Continental-type' distribution, being confined to a belt of country from Berks. to S.E. Yorks., where the terrain is similar to that of northern Germany, and chiefly on sandy soils; it is particularly frequent in the northern Cotswolds and along the lower Trent Valley. The known distribution is shown in Fig. 3 and includes v.c. 22, 23, 29, 30, 32, 33, 38, 39, 53–57, 61.

19. *R. hylophilus* Rip. ex Genev. (*R. brittonii* Barton & Riddelsd.)

British specimens of *R. brittonii* match well examples of *R. hylophilus* Rip. ex Genev. in **K** and Bat. Eur. no. 366 in **BM** and **MANCH**; the use of the name *R. hylophilus* is therefore justified for the British plant. The account and figure in Watson (1958) give a satisfactory impression of this species.

20. *R. thyrsanthus* Focke

Watson's single example of putative *R. thyrsanthus* (**SLBI**) appears to be a depauperate specimen or a recent hybrid derivative of *R. armipotens*. It is certainly different from *R. thyrsanthus* Focke, which I have collected from the Harz area in Germany (whence it was first described) and have verified with syntypes.

CONCLUSIONS

A revised British list of *Rubus* section *Discolores* is as follows:

Series *Gypsocaulones* P. J. Muell. (incl. *Hedycarpi* Focke)
- *R. ulmifolius* Schott
  - *R. rusticanus* Merc., *R. discolor* auct.
- *R. armipotens* Barton ex A. Newton
  - *R. pseudobifrons* auct.
- *R. winteri* P. J. Muell. ex Focke
- *R. rossensis* A. Newton
  - *R. crassifolius* auct.
- *R. lamburnensis* Rilstone
- *R. pydarensis* Rilstone
- *R. procerus* P. J. Muell.
  - *R. hedycarpus* Focke, *R. armeniacus* Focke

Series *Candicantes* Focke
- *R. neomalacus* Sudre
- *R. anglocandicans* A. Newton
  - *R. thyrsoideus* auct.
- *R. hylophilus* Rip. ex Genev.
  - *R. brittonii* Barton & Riddelsd.

ACKNOWLEDGMENTS

I am indebted to the Curators of the various herbaria cited for the loan of specimens, to E. S. Edees for his advice particularly on the treatment of Rilstone's taxa and for some distributional data, and to the Biological Records Centre for production of the maps from data supplied by me.

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(*Accepted June* 1976)

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The past and present status and distribution of Sea Pea, *Lathyrus japonicus* Willd., in the British Isles

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ABSTRACT

Lathyrus japonicus Willd. is a rare and declining species in the British Isles. From 1973 to 1975 beaches on which the species had been recorded in the past were visited and the present status recorded. There has been a marked reduction in the number of *Lathyrus japonicus* colonies and under half of those sites where it had once been recorded now contain the species. However, in E. Sussex, v.c. 14, and E. Suffolk, v.c. 25, the populations are expanding and at Chesil Beach, Dorset, v.c. 9, Rye, E. Sussex and Orford, E. Suffolk its continued existence seems assured. Elsewhere, human pressure or a change in physical conditions could rapidly eliminate the species.

The range of a plant species and its distribution within that range are frequently dynamic. This may be the result of physical or climatic changes, successional sequence or, above all, human interference. The Sea Pea, *Lathyrus japonicus* Willd., is an example of a species easily disturbed by man and it illustrates the care with which he must monitor his effects on the flora even in non-agricultural landscapes.

L. japonicus is a creeping or climbing perennial most commonly found on shingle beaches but occasionally recorded from dunes and other coastal habitats. It is fairly long-lived and once established it is not likely to disappear except where coastal changes or human pressure cause this to occur. Where beaches are accreting seawards and more closed vegetation enters as humus builds up, it disappears on older shingle but persists nearer the shore where the vegetation is open. This is particularly clear at Shingle Street, Suffolk, v.c. 25. A description of this species is given by Brightmore & White (1963), who consider that the British plant is *L. japonicus* var. *glaber* (Sér.) Fernald. However, a narrow-leaved variant, *L. japonicus* var. *acutiformis* Bab., is present in north-eastern Britain. This may well be a northern ecotype with distinct habitat preferences, since all the Scottish sites for the species are on sand-dunes and the dune plants in northern Jutland, Denmark, are similarly narrow-leaved. Conversely, the Danish plants growing on shingle are broad-leaved like the shingle plants of southern Britain (F. Rose, pers. comm. 1976).

L. japonicus is a northern plant with a disjunct circumpolar distribution. It formerly extended south into northern France but it is now extinct there. It is common in Denmark, especially in north Jutland in the dunes of the Hanstholm Nature Reserve and on shingle beaches between Struer and Thisted. With the exception of southern and eastern England, it is rare over much of the rest of the European coast and this is probably explained by the lack of shingle beaches. In Britain it has been recorded most frequently on the southern and eastern coasts from Chesil Beach, Dorset, to Benacre, E. Suffolk, but isolated colonies occur elsewhere. Its seeds are avidly eaten by birds, and many animals, especially sheep, find the whole plant palatable. The plants cease flowering and soon die when heavily or frequently trampled.

For many years *L. japonicus* has been regarded as a rare and declining species in the British Isles as excerpts from county Floras show:

DORSET 'Native; pebbly beaches; rare.' (Mansel-Pleydell 1895)

HANTS 'On pebbly and sandy sea beaches; very rare; only found in I. of W., and has not been seen for many years.' (Townsend 1904)

SUSSEX 'Native. Shingly shores: very rare. Now very nearly extinct, the specimen at Rye in 1931 being the last seen since 1878. . . . Its shyness in flowering and therefore inability to reproduce itself, and the rapacity of collectors when it does appear, sufficiently account for its disappearance.' (Wolley-Dod 1937)

KENT 'Native. Shingly shores; very rare. In some stations it seems to be extinct; but it may still be found at Dungeness and Kingsdown, in small quantity.' (Hanbury & Marshall 1899)

SUFFOLK 'On shingly shore; rare.' (Hind 1889)

However, population resurgences do occur and currently all these counties except Hampshire have colonies of some quantity. From 1973 until 1975 the population at Shingle Street, E. Suffolk, was much larger than that recorded in 1962 and Brightmore & White (1963) suggest that an exceptional spread of *L. japonicus* at Rye Harbour from 1962 until 1964 resulted from dispersal of seeds by flocks of stock dove, *Columba oenas* L. This colony has remained large to the present day.

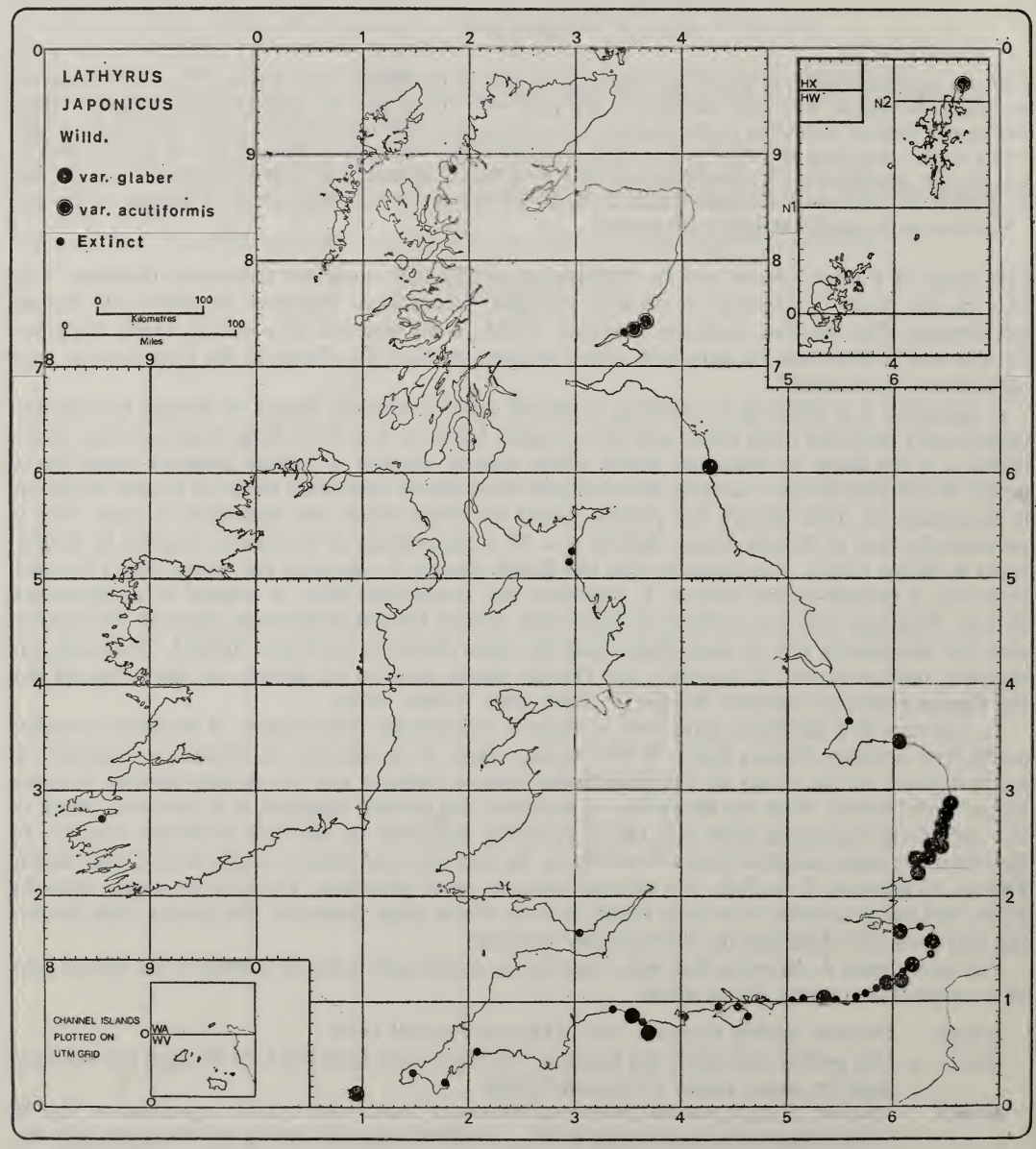

FIGURE 1. Distribution of *Lathyrus japonicus* in the British Isles.
Map compiled by the Biological Records Centre, Monks Wood.

TABLE 1. PLANT SPECIES FREQUENTLY ASSOCIATED WITH *L. JAPONICUS* IN THE BRITISH ISLES

Based on data collected by the author and within 5m square quadrats

Agropyron junceiforme	*Lupinus arboreus*
Ammophila arenaria	*Medicago arabica*
Arrhenatherum elatius	*Medicago minima*
Atriplex sp.	*Montia perfoliata*
Bellis perennis	*Plantago lanceolata*
Beta vulgaris	*Plantago coronopus*
Bromus mollis	*Rumex crispus*
Cirsium arvense	*Sedum acre*
Crambe maritima	*Senecio jacobaea*
Echium vulgare	*S. viscosus*
Epilobium angustifolium	*Silene maritima*
Erodium cicutarium	*Solanum dulcamara*
Festuca rubra	*Tamarix anglica*
Geranium robertianum	*Trifolium pratense*
Glaucium flavum	*T. repens*
Hieracium pilosella	*T. suffocatum*
Honkenya peploides	*Tripleurospermum maritimum*
Lathyrus nissolia	*Vicia hirsuta*
Leontodon autumnalis	*V. lathyroides*
Lolium perenne	*V. lutea*

Because of the uncertainty of the present distribution of this species and the scant knowledge of the population size at any of the recorded sites, a study was undertaken from 1973 until 1975 to assess the distribution and status of *L. japonicus* on the coasts of the British Isles. Enquiries were also made of many shingle researchers to discover their knowledge of the species' present distribution. Full data from each site have been lodged with the Biological Records Centre, Monks Wood. The following records describe the current situation and trends. Fig. 1 illustrates the present distribution of *L. japonicus* in the British Isles and Table 1 shows the more important associated species.

With the exception of a new site first recorded in 1972 on St Mary's, Isles of Scilly, v.c. 1, *L. japonicus* is now absent from all four of its former sites west of Chesil Beach, Dorset; these are Penzance and St Keverne, W. Cornwall, v.c. 1, St Austell, E. Cornwall, v.c. 2, and Charmouth, Dorset, v.c. 9. This area of England has become one of the major tourist regions in the post-war period and a marked reduction has occurred in the quality and quantity of beach vegetation in general. The first record of *L. japonicus* from Chesil Beach, Dorset was in 1799. Mansel-Pleydell (1895) and Good (1948) mentioned that it grew only intermittently along the beach. In 1973 a zone of *L. japonicus* was found along much of Chesil Beach just landwards of the crest of the shingle ridge and extending for great distances along the beach. In places it disappeared for some distance only to reappear a few hundred metres further on. This is certainly the largest population of *L. japonicus* on the south coast of Britain and is rivalled only by the extensive recent spread at Rye Harbour. Chesil Beach has been scheduled as a Site of Special Scientific Interest but it is not within a nature reserve.

From Chesil eastward to Brighton, E. Sussex, v.c. 14, *L. japonicus* has been recorded in seven localities but in 1973 the only site found was within the fenced enclosure of Volk's Railway on Brighton beach. It is now absent from Poole, Dorset, Hurst Castle spit, S. Hants, v.c. 11, East Cowes and Sandown, Wight, v.c. 10, Kingston and Worthing, W. Sussex, v.c. 13. Again, this is an important holiday area but considerable stretches of the coast have also been altered for sea-defence purposes. A small patch, about 1 m^2, occurred at Pagham Harbour, W. Sussex, in 1972 but timber dumping had eliminated it in 1973. F. Rose (pers. comm. 1976) reports, however, that it has re-appeared in 1976. East of Brighton, it had been recorded at Seaford, Pevensey, Bulverhythe (until 1960s) and Hastings, all in E. Sussex, v.c. 14, but it is now extinct at each site.

In eastern E. Sussex, v.c. 14, and E. Kent, v.c. 15, *L. japonicus* is much more abundant. In the former it is present in great quantity for over 3 km of shingle from Winchelsea Beach to Rye Harbour

and on to Camber Sands, where it becomes a dune species. It is most abundant on new shingle ridges but persists locally as these become covered with blown sand east of the estuary of the River Rother. East of Dungeness power station, E. Kent, there is a colony which has increased considerably between 1946 and 1973, though two other colonies nearby known in the 1940s have now apparently disappeared. Along this stretch of coast, especially at Winchelsea and Dungeness, pressure from tourism and fishing have made some colonies poor or non-flowering, but at Palmarsh, west of Hythe, a colony first recorded in 1954 on the rifle-range is expanding.

Elsewhere in E. Kent, *L. japonicus* is now absent from its old sites at New Romney, Kingsdown and Reculver, although it still persists at Walmer and at Whitstable, where it was first recorded in the 1970s. Walmer beach is heavily used by holiday-makers but there is a wooden track across the shingle to which most visitors keep. This has reduced the pressure on the beach vegetation and the colony of *L. japonicus* is expanding. Perhaps this augers well for future conservation of the species and suggests a satisfactory means of reducing trampling on the species at other sites. F. Rose (pers. comm. 1975) saw *L. japonicus* 'in local plenty' about 2 km west of Minnis Bay, Reculver in the early 1960s but inroads by the sea and the erection of a new sea-wall have eliminated it.

The only two N. Essex, v.c. 19, sites are both recent ones. Jermyn (1975) mentioned that it occurred at Walton-on-the-Naze in 1964 and that it was still present in 1971; it was also recorded just north at Little Oakley in 1970. All eight sites from which *L. japonicus* has been recorded in E. Suffolk still contain the species and in several places, for example Orford Ness, Shingle Street and Benacre, it is increasing. At Landguard Point and Thorpeness the populations are dwindling rapidly because of human pressure. The other sites are Felixstowe Ferry, Minsmere, Dunwich and Walberswick. Records suggest that until about 1850 Aldeburgh was its northern limit in East Anglia but now it seems to be spreading very considerably north to Benacre. The Orford Ness/ Shingle Street area has vast mats of *L. japonicus* over the apposition banks (Randall 1973); this is the largest population in the British Isles and is only exceeded on the Continent by those along the west coast of Jutland. The Suffolk coast is much less used by tourists than the south coast of Britain, although pressure has increased markedly in recent years. Orford Ness is part of a National Nature Reserve and is virtually inaccessible except by boat, but Shingle Street is unprotected. Caius (1570) noted that between the towns of Orford and Aldeburgh, in the autumn of 1555, peas grew of their own accord in such great abundance as to be sufficient even for thousands of people. This is the earliest record for *L. japonicus* in the British Isles.

L. japonicus seems not to have been part of the indigenous flora of Norfolk in historic times and several attempts to establish it there this century have failed after a few years. At present a small patch about 2 m^2 still exists on Cley beach, Norfolk, v.c. 27, just west of the coastguard lookout. In Lincolnshire, it is now extinct but there are new records in the 1970s at Warkworth and Birling Links, Cheviot, v.c. 68.

Scotland has had three isolated populations of *L. japonicus*: one by the Firth of Tay, Forfar, v.c. 90, one on Unst, Shetland, v.c. 112, and one by Loch Ewe, W. Ross, v.c. 105. At the first of these populations it disappeared near Monifieth as a result of industrial activity but it still exists in two small areas, one near Carnoustie and the other near Arbroath. Both sites are on golf-links. In Shetland, the population has disappeared at one site through gravel extraction and recreation and at the other it has been reduced to under 2 m^2 by similar pressures. The Loch Ewe colony has also disappeared.

Hodgson (1899) recorded *L. japonicus* from Harrington and St Bees on the Cumberland coast, v.c. 70, but these colonies have now disappeared, as has also that at West Aberthaw, Glamorgan, v.c. 41, as a result of the construction of a power station and heavy use of the area for fishing. However, a single plant was reported at Seascale, 15 km south of St Bees, in 1975.

For many years *L. japonicus* was recorded at Rossbeigh, S. Kerry, v.c. H1, and also across the bay at Inch. It has not been seen at the latter site since before 1916 and although collections have been made from Rossbeigh in recent years, it was not found in 1973 (Scannell per. comm. 1975).

Thus it can be seen that there has been a drastic reduction in the number of *L. japonicus* sites although the species has certainly increased locally on the Sussex and Suffolk coasts. The disappearance of *L. japonicus* from many of the remaining areas can be attributed in part to shyness of flowering (Lousley & McClintock 1951) but above all to human use of the beaches concerned. It seems that the present climate in southern and eastern England would enable it to grow very vigorously were it allowed to do so, but this may not be the case further north or west. It seems

that shingle extraction is totally responsible for its elimination from its only French locality, on shingle south of the mouth of the River Somme. Lack of grazing in the twentieth century may well have helped the species considerably in southern and eastern England. Where trampling does not occur, such as at Walmer, even heavily-used beaches retain good populations. As it is a plant of the mobile foreshore, there are bound to be natural changes or fluctuations in its distribution, and some extinctions can be attributed to local land-erosion. However, the most stable sites physically are those where the vegetation is more closed and where there is greatest risk from human activity. Thus the long-term outlook for the species in many areas is bleak. The populations at Chesil Beach, Rye Harbour and Orford Ness/Shingle Street are by far the largest and are the only ones in which its continued existence seems assured, unless deliberate protective measures are taken elsewhere.

ACKNOWLEDGMENTS

This research was financed by the World Wildlife Fund. I should like to thank Dr F. Rose and Dr F. H. Perring for their criticism of this study and for help in obtaining data.

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(*Accepted June* 1976)

Short Notes

RUBUS SPRENGELII WEIHE IN SCILLY

After many years of combing Cornwall and western Devon for brambles, Rilstone (1952) was able to report *R. sprengelii* Weihe—perhaps the most distinct of all the British species—in only a single locality: near Penzance, W. Cornwall, v.c.1. There was also one old record from Valency in the literature that he believed correct.

In view of this great rarity in the Cornish peninsula it was with some surprise that in a fortnight's visit to the Isles of Scilly in June 1975 I came across the species in no fewer than four places. Three of these were on Tresco: small patches by two successive cross-paths on Middle Down and a patch bordering bracken by the south tip of the Great Pool. On St Mary's, which I sampled much more cursorily, it was frequent under bracken round Innisidgen burial chamber. Similar habitats occur in plenty almost throughout the islands and there seems no reason why the species should not prove widespread. On the other hand it was not among the *Rubi* that F. Townsend collected on his major exploratory visit in 1862—the only extensive sampling of the Scilly brambles hitherto (Lousley 1971).

There are other plants, such as *Ornithopus pinnatus* (Mill.) Druce, that occur widely in Scilly but are missing from the Cornish mainland, but it is unexpected that a member of a genus so readily dispersed by birds should exhibit this pattern.

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D. E. Allen

CAREX POLYPHYLLA KAR. & KIR. AND *C. LEERSIANA* RAUSCHERT

Since the writing of David's paper (1976) on the nomenclature of the *Carex muricata* L. aggregate, we have, through the kindness of the curator of the herbarium of Moscow University, been able to examine the type material of *C. polyphylla* Kar. & Kir. in **MW**. There are two sheets, both carrying the tickets of Karelin and Kirilov, 1841, and both determined as *C. polyphylla* Kar. & Kir. by Kreczetowicz in 1937. They bear no localities, but can be assumed to originate 'in sylvaticis ad torrentem Tscheharak-Assu, circa montes Tarbagatai, 1840' in E. Kazakhstan. These are the only specimens collected by Karelin and Kirilov that are extant and that can be considered type material. One, numbered 2075 and 227279, is labelled 'Isotypus' in recent hand-writing, and contains one specimen so incomplete that we cannot be certain what it is. The other, numbered 2081 and 227274, is labelled 'Typus' in the same recent hand-writing, and contains two very adequate specimens, in excellent condition, which we here take the opportunity of designating as Lectotype. (Alekseev (1973) commented that one must reckon as the type the specimen in **MW** bearing both Karelin and Kirilov's and Kreczetowicz's labels, but did not mention that there are two sheets to choose from.) The lectotype material corresponds in every respect with *C. leersiana* Rauschert (*C. leersii* F. W. Schultz, non Willd.). Further, more recent, collections in **MW**, determined as *C. polyphylla* by Kreczetowicz and others, from the southern parts of the U.S.S.R. ranging from the Crimea to Lake Baikal, exactly match the lectotype and indicate that this taxon is widespread in the area.

Thus, if *C. leersiana* Rauschert is considered as a distinct species, its correct name is *C. polyphylla* Kar. & Kir. The extreme form of the taxon (as in the type) is indeed very different from the extreme form of *C. divulsa* Stokes, but these extremes are linked by a series of intermediates so that no clear morphological dividing line can be drawn. The same conclusion was reached by Medovič (1960),

who, in a comprehensive series of statistical analyses, failed to separate *C. leersiana* from *C. divulsa*. In our opinion, the only possible course, unless further studies succeed in establishing some means of separation, is to regard *C. polyphylla* Kar. & Kir. as a subspecies of *C. divulsa*, and at this rank the correct name of the taxon remains *C. divulsa* subsp. *leersii* (Aschers. & Graebn.) W. Koch.

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R. W. DAVID & A. O. CHATER

CHROMOSOME NUMBERS OF BRITISH PLANTS, 5

	Chromosome number	Grid reference and locality
Hippocrepis comosa L.	$n = 7$	21/89.76 St Bride's Valley, Glamorgan, v.c. 41
	$n = 7$	21/57.87 Pwlldu, Gower, Glamorgan, v.c. 41
	$n = 7$	20/92.62 Daddyhole Plain, Torbay, S. Devon, v.c. 3
Juncus articulatus L.	$2n = 80$	28/50.57 Loch Ussie, E. Ross, v.c. 106
	$2n = 80$	35/83.31 Sand Sike, Upper Teesdale, Durham, v.c. 66
Carex paupercula Michx.	$n = 29$	35/81.29 Cow Green, Upper Teesdale, Westmorland, v.c. 69
	$n = 29$	26/68.32 Glengavel, Lanark, v.c. 77
Alopecurus alpinus Sm.	$n = 50$	35/70.33 Little Dun Fell, Westmorland, v.c. 69
	$2n = 117$	37/16.76 Glas Maol, Forfar, v.c. 90

G. M. FEARN

PHYTEUMA SCHEUCHZERI ALL. NATURALIZED IN OXFORD

Phyteuma scheuchzeri All., a native of the southern Alps from Piedmont and Valais to Croatia, and first recorded in cultivation in Britain in 1816 (Sims 1816), has in recent years become established on the wall of St Johns College gardens, Oxford. A specimen collected by me in 1960 is in **OXF**. Allied to *P. tenerum* R. Schultz, it may be distinguished as follows:

Basal leaves (in the Oxford plant) ovate to lanceolate, long-petioled, cordate to truncate at base; stem-leaves few, linear-lanceolate, distinctly stalked; leaves all with shallow, distant teeth, or the uppermost subentire. Inflorescence capitate. Bracts linear-lanceolate, conspicuous, much exceeding inflorescence, often curving downwards. Corolla deep blue, straight in bud; stigmas three. Flowering late May to June, the withered heads persisting.

From enquiries made, *P. scheuchzeri* seems to have first appeared on the wall about 1951. It evidently originates from St Johns College gardens to which, as Mr K. E. Bull has suggested to

me, it may have been introduced by Rev. H. J. Bidder (1847–1923), a former bursar of the college who collected many choice plants in the Alps and Pyrenees for the rockeries (Druce 1924). But it has now spread to the outer side of the wall, both in Parks Road and the court of the School of Agricultural Science, and to pavements nearby, and seems at least as worthy of record as such aliens as *Chondrilla juncea* L. and *Melica ciliata* L., which temporarily established themselves on Oxford walls in the past (Druce 1886).

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R. C. Palmer

WHITE-FLOWERED BLUEBELLS (*ENDYMION NON-SCRIPTUS* (L.) GARCKE)

Despite the wide distribution and abundance of *Endymion non-scriptus* (L.) Garcke in Britain, very little is known of the white-flowered form, which appears to be equally widespread although sporadic and never common. The following observations on this form have been prompted partly by Harborne's (1967, p. 257) statement that a general 'characteristic of white flower mutants of coloured forms is their unthriftiness as plants'.

A population of white-flowered plants in a wood north-west of Cronton, S. Lancs., v.c. 59, was studied between 1967 and 1971. Although the wood contains an estimated 60,000 blue-flowered plants, the number of white-flowered individuals seen annually ranged from 16 to 22. Populations with this proportion of white-flowered plants appear to be fairly general. Over the above five-year period counts were made of the number of flowers, capsules and seeds per inflorescence. It was found that white-flowered plants had a mean of 4·7 flowers (blue-flowered 5·5) 2·1 capsules (3·7) and 23 (45) seeds per inflorescence, the average number of seeds per capsule being rather similar in each. It was not possible to follow all the original flowering plants through to seeding, so the sample-size progressively decreased.

Four plants of each colour, transplanted to a garden from the Wrekin, Salop, v.c. 40, produced the same number of flowers per inflorescence, although the white-flowered plants had fewer capsules. It may be that the latter plants flower less freely when in competition with blue-flowered ones in the wild.

Germination of seeds collected in the wild from white- and blue-flowered plants and sown in a garden was similar, mostly 20–30% after eight months from collection. All 26 plants raised from seeds collected from white-flowered individuals proved ultimately to be blue-flowered.

These observations confirm Harborne's suspicions on the generally lower reproductive efficiency of albino plants and they also demonstrate a high level of outbreeding in the bluebell.

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R. W. Riding

POLYGONUM MINUS HUDS. × *P. PERSICARIA* L. IN ANGLESEY

In July 1975 a plant which appeared to have a combination of the characters of *Polygonum minus* Huds. and *P. persicaria* L. was found on the muddy shore of Llyn Coron, near Aberffraw, Anglesey, v.c. 52. This is the only known Anglesey locality for *P. minus*, but this species occurs here in good

numbers and often grows intermingled with *P. persicaria*, occasionally with plants of the two species actually touching.

The features which made the plant conspicuous in the field were the decumbent habit and narrow, interrupted inflorescence as in *P. minus*, and the blotched leaves as in *P. persicaria*. Although a careful search of the site was made, no other plant of the same kind was seen. As the plant was branched from the base and rooting at the lower nodes, a portion was removed and potted in compost kept moist by standing in a pan of water, where it grew vigorously.

Further observations on this plant showed that it was intermediate between the putative parents in a number of characters. A comparison of it with *P. minus* and *P. persicaria* from the same locality is shown in Table 1.

TABLE 1. COMPARISON OF *POLYGONUM MINUS* HUDS., *P. PERSICARIA* L., AND THE PUTATIVE HYBRID

	P. minus	Hybrid	*P. persicaria*
Habit	Decumbent	Decumbent	Upright or ascending
Stem	Slender	Intermediate	Stout
Inflorescence	Very slender (*c* 3 mm wide); interrupted at base	Slender (*c* 5 mm wide); interrupted at base	Stout (*c* 7–9 mm wide); scarcely interrupted at base
Leaf width	Up to 7·5 mm	Up to 9 mm	Up to 12 mm
Leaf length: width ratio	7–8	4·5–5·5	4–5·2
Leaf venation	Inconspicuous beneath	Fairly conspicuous beneath	Conspicuous beneath
Leaf marking	None	Blotched	Usually blotched
Perianth colour	Pink	Greenish, tinged with pink	Greenish, tinged with pink
Seed length and breadth (mean of ten seeds)	1·7 × 1 mm	2·1 × 1·3 mm	2·6 × 2·1 mm

The pollen appeared to be normal, though the pollen grains were smaller (*c* 40 μm diameter) than in either of the parents (*c* 50 μm in *P. minus*; *c* 44 μm in *P. persicaria*). Seed production also seemed to be normal, but the seeds were intermediate in size and shape between those of the parents.

Herbarium specimens taken from the plant later in the season were sent to Dr J. Timson of the Department of Medical Genetics, University of Manchester, who (Timson *in litt.* 1975) agreed that 'it may well be the hybrid since all the characters are intermediate'. The specimens have been deposited in **NMW**.

Timson (1965) has pointed out that interspecific hybrids in *Polygonum* Section *Persicaria* appear to be extremely rare in Britain; out of seven herbarium sheets of putative *P. minus* × *P. persicaria* examined by him, only one could be identified as the hybrid and that rather uncertainly. This specimen (**BM**) was collected by B. Welch in September 1955, on Ham Common, Richmond, Surrey, v.c. 17. There are unsubstantiated records of this hybrid from v.c. 11–14, 22 and 23 (Timson 1975), but, apparently because of his uncertainty, Timson (1975) did not cite the Surrey record.

The chromosome numbers of *P. minus* and *P. persicaria* are very close to one another: *P. minus* has $2n = 40$, *P. persicaria* has $2n = 44$. It is possible, as Timson (1965) has suggested, that their hybrid may be capable of some satisfactory meioses and thus account for the production of the normal-looking pollen and seeds.

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R. H. ROBERTS

VULPIA HYBRIDA (BROT.) PAU, NOMEN AMBIGUUM

In an earlier note (Stace & Cotton 1976) we pointed out that the plants which occur in this country as wool aliens under the name *Vulpia australis* (Steudel) Blom are in fact identical with the southern European *V. broteri* Boiss. & Reut., for which the correct name is *V. muralis* (Kunth) Nees. Our reasons for using the name *V. muralis* were not, however, stated adequately, and the purpose of this note is to rectify the omission.

The basionym of *V. muralis* (*Festuca muralis* Kunth) was published in 1822, and easily predates the publication of *V. broteri* Boiss. & Reut. in 1852. However, the name *V. hybrida* (Brot.) Pau, based on *Festuca hybrida* Brot., published in 1804, has also been used for the same plant and, of course, if it could be typified accordingly it would be the correct name. There is, unfortunately, uncertainty as to the application of the name *Festuca hybrida*, as indicated by Boissier & Reuter's (1852) unwillingness to use it for the plant they named *V. broteri*. As pointed out by Hackel (1880) and by Kerguélen (1975, p. 285), it seems that Boissier & Reuter considered that Brotero confused two plants, or that his description and type did not match.

It appears that Brotero's herbarium has been lost or destroyed (Paunero 1964, p. 94; A. Fernandes *in litt.* 1973) and, in view of this and the uncertainty of the application of the name *F. hybrida*, we (like Paunero) prefer to treat it as a *nomen ambiguum*. Until such time as *Festuca hybrida* can be typified, the name used for the plant in question must be *V. muralis* (Kunth) Nees.

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C. A. Stace & R. Cotton

Book Reviews

The Naturalist in Britain. D. E. Allen. Pp. xii + 292, with 13 black and white plates and 16 line illustrations. Allen Lane, London. 1976. Price £9·00.

The Naturalist in Britain is the unusual subject of this book, which traces the development of studies in natural history in the British Isles from 1600 to the present time. The 280 pages of concise and authoritative text are the results of 20 years' research by the author, David Elliston Allen, who, with his special interest in social history and experience in geographical recording of man and other subjects, is well qualified to tackle the wide ramifications of his chosen topic. The author's link with the B.S.B.I. is revealed on page 1, where he tells us that the idea of the book arose from his small exhibit on the Society's membership (in 1952), showing how the alteration of its social composition had closely followed broad national patterns.

The organization of studies in natural history is found to interrelate with the social fashions and economic conditions of past centuries, and Mr Allen describes the origins of societies for botany, geology, entomology, and taxidermy leading to ornithology and allied subjects. Also, the history of the distinctive tools of each calling (e.g. hammer, vasculum and butterfly net), whose use was in many cases furthered by eccentrics who stamped their powerful personalities on the studies of their day, is traced. Groups of enthusiasts formed the early societies; the account shows how much of our present comprehensive knowledge of our native flora and fauna is based on the painstaking observation and record-keeping of the early collectors and the continuity of their records through four centuries through these Societies, of which the first in Britain was the Temple Coffee House Botanic Club. Later the drawing-room hostesses originated 'conversazione'—a word still used in this society's calendar of events in most years. In turn the impact of natural theology, the turbulent introduction of Linnaeus's new method, and the romantic movement of early Victorian times, followed by the links with professional science, are demonstrated. The influence of the fashionable collectors, peers of the realm and private patronage are then recounted with humour and a wealth of anecdote. Other topics woven into the narrative include transport, photography and publications, all with facets relevant to the theme.

From the 17th century, botanists were to the fore due largely to the practical application of botanical studies through medicine, and there are evocative descriptions of days of simpling and herbarizing, also of expeditions in swaying horse-carriages (no travel pills in those days!), and tales of hardship and endurance associated with the botanical excursions. But one can envy the botanical discoveries of early expeditions and feel a link with the Cambridge undergraduate of 1755 who was 'seized by the challenge of finding and adding to the localities for the rarer plants recorded by Ray in his early Flora of the area'. But we can claim a change of attitude from the botanist of whom it was said 'he has charge of the physic garden of the apothecaries but treats it right scurvily, allowing no plants to multiply but either sticking them into his books or sending them away in exchange for others'.

Five hundred individual naturalists are mentioned by name, but this book is by no means a catalogue. The pages are packed with facts and information: one learns that 'the accession of George III in 1760, had among its many effects, the minor and rather freakish one of placing at the nation's head for the brief space of just two and a half years a trio of enthusiastic botanists', or that Englishwomen had a reputation for 'strolling excessively in their garden—the French claimed it gave them big feet'.

In addition to a careful index, particularly useful are ten pages of notes on sources which show the wide range of research, much of the material being hidden in little-known papers, the relevant significance of which this book brings to light. Some intriguing period illustrations add to the enjoyment.

This book has been received with well-deserved wide interest, covering as it does a field of research

which is not only unique but one with many ramifications. It is one for both browsing and reference, and I would suggest that it will be a source of information and pleasure for many years ahead—by which time its present somewhat breath-taking cost will most probably be regarded as a mere trifle.

M. Briggs

The Seeds of Dicotyledons. A. J. H. Corner. Vol. 1, pp. xii+311; vol. 2, pp. viii+552 (647 figs). Cambridge University Press, Cambridge. 1976. Price vol. 1, £15·00; vol. 2, £25·00.

Professor Corner's new topic is the structure of the seed-coat; his theme is again the phylogeny of the flowering plants. The taxonomic use of seed shapes and surfaces is commonplace, and in recent years such studies have often been supplemented by beautiful photographs from the electron scanning microscope. Corner's subject-matter lies far from such superficial detail; it is the basic anatomical structure of the seed-coat and more especially that of seeds derived from ovules with two integuments, these being characteristic of most of the families we believe to be primitive. Each integument, of course, has an inner and an outer epidermis and between them is mesophyll. Thus there are six histological layers whose differentiation needs to be traced from ovule to seed. In addition there are the possible complications of arils, chalazal growth, vascularization and micropylar detail. One thing, then, is beyond dispute: seed structure is as much an integrated system as flower-structure; it is not to be dismissed as a unitary character.

Argument and discussion occupy 60 concentrated and often provocative pages. The descriptive data (for the most part new) take up the remaining pages of volume 1. The whole 552 pages of volume 2 are devoted to the illustrative line drawings, many of them of great complexity—and often of fascinating beauty (e.g. Figs. 37 and 38 of *Bixa*, Fig. 94 of *Sarawakodendron*). These are, of course, Corner's own work. The whole book is a tremendous achievement. £40 is a high price for two books, but is it so much for the results of many years' devoted, original and stimulating research?

The data that are fundamental for Corner's thesis relate to the seed-coats of Magnoliales. These are shown to be both complex and diverse in respect of which layer or layers show mechanical strengthening; in fact eight main types are recognized, but the basic structure is constant within a family. Corner's conclusion is that the proto-angiospermous ancestor of these living families had a seed which developed a seed-coat of considerable complexity, and that the Magnolialean types represent different phyletic lines of simplification. These lines show further simplification in more advanced families, but nevertheless structure is often persistent enough to enable affinities to be traced. It is suggested that the nutmeg family, Myristicaceae, shows the closest approach among living dicotyledons to the seed structure of the early angiosperms.

For clarity of description Corner reserves the terms inner and outer integument for the ovular structures; for the seed he changes to testa for the outer and tegmen for the inner. Thus a mesotestal seed has its predominant seed-coat layer developed from the mesophyll of the outer integument of the ovule, an exotegmic one from the outer epidermis of the inner integument.

When reviewing Takhtajan's *Flowering Plants, Origin and Dispersal* a few years ago, I criticized that author for apparently relying solely on pollen structure to transfer Illiciaceae and Schisandraceae from Magnoliales (monocolpate) to Ranunculales (tricolpate). Perhaps I owe Takhtajan an apology, for Corner makes the same move on the basis of seed-coat structure; however, Corner includes the monocolpate Winteraceae in this transfer, taking seed-coat in this case to outweigh both pollen and the presence of aromatic oil-cells. There are a number of other suggestions that will cause some surprise: Cruciferae are perhaps linked to Polygalaceae, rather than to Papaveraceae or Capparaceae; Proteaceae may be linked to Papaveraceae. There are many more and it is clear the the digestion of this new information into a general system will require careful thought. Although Corner clearly feels that the families commonly grouped as Magnoliales (in the widest sense) need realignment into a number of distinct orders, he very wisely refrains from any name-making at this stage. He refers repeatedly to the limited material available to him and clearly there is much more to be done before the complete implications of this line of research are fully realized.

Corner adduces from these studies of seed-coats much support for his views on angiosperm origins, which are commonly known as durian-theory. This he is well entitled to do. However the

issues must not be confused. This work on the structure of seeds stands as a major contribution to botanical knowledge in its own right.

The taxonomic scope of the book will make it difficult for those who lack some knowledge of tropical and subtropical families; yet in this very fact it provides cogent argument for the view that the understanding of the angiosperms lies in tropical botany. But Corner does not neglect the temperate: *Aquilegia*, *Althaea*, *Berberis*, *Chelidonium*, *Euonymus*, *Helleborus*, *Hypericum*, *Oenothera*, *Paeonia*, *Polygala*, *Ruta*, *Tilia*, *Vancouveria* are all here in novel detail.

I have a personal dislike for the larger page which demands a double-column setting. Good English deserves a better fate than burial in a narrow column. That apart, the Cambridge University Press have done a very good job; misprints are trivial and the reproduction of the drawings is constantly excellent. This book is essential study for anyone interested in the evolution of the angiosperms; it is essential for any department teaching angiosperm classification; it is a splendid example for students of what can still be done by individual research.

B. L. Burtt

Biological Identification with Computers. Edited by R. J. Pankhurst. Pp. x+333. Systematics Association Special Volume No. 7. Academic Press, London. 1975. Price £11·00.

Those readers of *Watsonia* who are not at ease with the computing mathematical component in many recent taxonomic papers should read some (or parts of some) of the 16 contributions to this symposium volume (papers presented at a meeting of the Systematics Association in Cambridge in 1973). The remainder should read them all. I cannot summarize the detailed contents here; instead I shall try to encourage non-specialists to consult the volume, since the principles underlying so many of the papers must inevitably permeate the practise of taxonomy, to its everlasting benefit.

Computer programs are not themselves mathematics. They are the mode of communicating the sequence of instructions to a computer to enable it to perform certain calculations or data rearrangements which might well be too massive or complicated for an unaided or mathematically ignorant individual. But an initially less obvious benefit is that the methods of analysis require us to prepare our data in a strictly logical manner, indeed to compare like with like, and to define and standardize our terms. We need to have no fear of becoming automatons ourselves, since in spite of the hopes of the first numerical taxonomists, humans will almost always collect the initial data more or less subjectively, and must make equivalent interpretations at the end of the study.

Chapters 1, 2 and especially 14 outline the general principles of biological identification, and distinguish between classification (placing individuals along with others in more or less homogeneous groups) and identification (finding which group an as yet unclassified individual belongs to). An invaluable disciplinary benefit of incorporating computing into a taxonomic study is that one is forced into producing a full primary data matrix (i.e. all characters scored for all entities being studied). Deficiencies in the data matrices often mean that we have better means of analysis than data to analyse. A depressing conclusion is that many practising taxonomists are surprisingly illogical in their descriptive work and indeed frequently fail to eliminate avoidable errors. I would add from my own experience with bryophytes that a number of genera considered 'critical' owe this to poor quality keys rather than to any intrinsic taxonomic difficulties.

Chapters 3 to 12 discuss (sometimes fairly technically) programs and techniques for key construction and automatic identification. The polyclave keys discussed in chapter 5 avoid the shortcomings of traditional dichotomous keys, and allow characters to be employed in any order, some even permitting the comparison of a range of characters simultaneously. Many of these keys can be prepared by hand, and the majority can be used independently of any computer. They go a long way to dissociate keys for identification from systems of classification, with which they have been so confused in the past.

Although medical diagnosis is otherwise excluded from the present volume, chapters 8, 9 and 11 make use of studies in bacteriological identification to illustrate some important contributions to general classification and identification theory. Microbiologists often need to search through great quantities of data, and their identifications really matter. Does it 'matter' so much that the *Salicornia* I have just eaten is *S. fragilis* rather than *S. obscura*? Maybe the precise strain of *Escherichia coli* (or worse) sitting on it matters more . . .

Summaries usually make easier reading than the material they summarize, so I recommend non-specialists to read chapter 16 and the four subsequent discussion papers. The volume concludes with a bibliography of papers on computing and identification, a list of relevant computer programs (directly concerned with identification or data capture) and a valuable glossary of terms. Incidentally, these terms used by computer scientists are a study in themselves—are our data so wild as to need capturing? Perhaps they are.

D. H. Dalby

The Natural History of Upper Teesdale, revised edition. Edited by M. E. Bradshaw. Pp. 75. Durham County Conservation Trust Limited. 1976. Obtainable from the Hon. Sales Officer, 1 Abbey Road, Darlington. Price 45p.

This paperback booklet supplants the first edition of 1965 and within 61 pages of text (plus Notes for Visitors, Preface and Appendices of Latin names) covers, in seven chapters, a range of natural history subjects.

The flora, including its history and vegetation (M. E. Bradshaw and W. A. Clark), has received very full treatment—logically, since Teesdale is internationally famous for this, above all else. Sadly, if typically, few concessions are made to the increasing number of amateur bryologists who will visit the area, and none at all to lichenologists. At least the bryophytes, in my experience, supplement many of the comments made about the more spectacular flowering plants.

Mankind (H. G. Proctor) is a chapter on the history of settlement and population movements which vividly captures the imagination, although the reader is left with rather vague impressions (chapter 7) about post-1905 and present-day activities of Teesdale residents. A supplementary short chapter on current land-use, and the influence on human resident populations of increased visitor-pressure, would have been welcome.

The Invertebrates (J. C. Coulson) concentrates, understandably, on insects and should encourage entomologists, arachnologists and others to scurry up the Fells with nets and jars and add more interesting species to the English or British fauna. This is less likely among the vertebrates, the chapter on which (C. S. Waller and D. T. Crisp) will probably be of most use to ornithologists.

The regional geology is fully and plainly laid out by G. A. L. Johnson, but I would have welcomed a few illustrations of the more conspicuous fossils, and perhaps a selection of mineral crystals, which are often seen in the exposed limestones and numerous spoil-heaps of the area.

The final chapter, on conservation (D. J. Bellamy), while dealing in a full and balanced way with the problems of Teesdale in particular, has much wider implications. One hopes that his cautiously optimistic note (p. 67) will be supported by future developments.

There are fine illustrations by P. Nicholas, and the drawings by M. E. Bradshaw of Teesdale plant specialities, although of simpler line, adequately capture their habits. The general map (p. 4) is, however, somewhat diffuse, and would benefit from bolder treatment of the Cow Green Reservoir, settlements, paths and boundaries, which are rather faint in this reproduction. The accent on birds, too, I find a little irritating, and their appearance at the head of chapters on invertebrates, flora and conservation in addition to their more logical one above Vertebrates, seems inappropriate (why not, for example, a Northern Eggar or selected pollen grains in the appropriate places?).

The booklet is packed with interesting information for the field and, to a lesser extent, armchair naturalist. Its overall tone seems to be aimed primarily at the educated visitor having some previous experience or training in a biological or geological field, but it has much to offer the casual layman. I believe it will prove to be an essential companion to the handbooks of the field naturalist visiting Teesdale and, moreover, at a price that is very favourable by any standards.

A. Eddy

Flora van Nederland. H. Heukels, 18th edition. Edited by S. J. Van Ooststroom. Pp. 913, with 1 map and 1,038 line-drawings. Wolters-Noordhoff, Groningen. 1975. Price Dfl. 43·25.

The latest edition of this well-known Flora of Dutch vascular plants is again edited by Dr Ooststroom. That it is only two years since the 17th edition is presumably testimony both to its popularity and the frequency of revision.

In his Foreword, Dr Ooststroom tells us that a number of new finds and distributional changes have been incorporated, together with sundry classificatory changes and references to recent literature. Some of these have been incorporated in the text, others are given in the Addenda (pp. 911–913).

The long introductory section includes four keys: a traditional one to families and certain genera; one based on the 'Linnaean system' in which the emphasis is on genera rather than families; a third for species which seldom flower, have inconspicuous flowers or are otherwise difficult to identify; and a fourth to trees and shrubs. There are brief notes, and a map, of the major phytogeographical divisions of the Netherlands and a detailed account of the classification of Dutch plant communities. The descriptions of individual specimens include references to distribution, the relevant plant communities and literature references, which are all the more valuable for being fuller than those we are accustomed to. Protected species are indicated and most species are illustrated by small line-drawings.

The nomenclature is, in the main, conventional and none the worse for that. Many will welcome the traditional treatment afforded to *Anthemis* and *Matricaria* and the demotion of *Arenaria leptoclados* to *A. serpyllifolia* subsp. *tenuior* (Mert. & Koch) Archang. Clearly the nomenclature does not follow *Flora Europaea*, but current usage (where different) or alternative treatments, are often indicated. Thus, in the Addenda we are told of the generic splits of *Lycopodium* and of the generic treatment of *Hepatica* and *Ficaria*. An exception is the *Euphrasia* account, which I found impossible to square with that in *Flora Europaea*. Surprises include the treatment of *Polystichum setiferum* (diploid) as a subspecies of *P. aculeatum* (tetraploid), and the generic status accorded to *Lemna polyrhiza* (*Spirodela*) and *Mentha pulegium* (*Pulegium*). The Addenda are important for descriptions of the two subspecies of *Myosotis palustris* and of *Veronica hederifolia*, and also for the inclusion of *Carex cespitosa* L., first discovered in 1973.

Without wishing to be patronising, this is very much a Flora for the amateur. There is virtually no experimental taxonomic information. No chromosome numbers are given (this will, no doubt, please some people), nor is there any reference to polyploidy, even though, for example, the tetraploid and hexaploid *Polypodium vulgare* are given specific status (surprisingly so in view of the treatment of *Polystichum*). There is no reference to apomixis under *Hieracium* or *Taraxacum*, but this is presumably because of the lack of all generic descriptions other than the appropriate lead of the family key. Hybrids are summarily dealt with, usually only by a note on their distribution. This is a pity. Personally, I would far rather have had more information on hybrids and other critical taxa at the expense of the disproportionate amount of space devoted to introduced and cultivated plants. The wild *Primula* hybrids may get short shrift but there are descriptions of seven cultivated taxa. Eight species of *Rhododendron* are included (surely a very arbitrary selection), as are 14 species belonging to five introduced genera of the Polemoniaceae.

No doubt this is a very personal view and there will be those who will value this Flora for precisely these reasons. Certainly it is a most useful Flora, attractively produced and not too large to be fairly described as pocket-sized.

G. Halliday

Cytotaxonomical Atlas of the Arctic Flora. A. & D. Löve. Pp. xxiii+598, with 1 map. J. Kramer, Vaduz. 1975. Price DM200.

As the authors say in their Introduction, the purpose of this Atlas is twofold. It provides for the first time both an exhaustive check-list of the Arctic flora and a list of all the chromosome numbers recorded for these taxa up to the autumn of 1975. It is their hope that by so doing they will both serve and advance the appearance of a comprehensive Flora of the Arctic.

Their southern limit of the Arctic in general follows the tree-line. Most of Fennoscandia is therefore excluded but Iceland is included. 404 genera and 1,629 species are listed and chromosome numbers are given for about 90% of these. This is nearly twice as many species as are included in *Circumpolar Arctic Flora* (Polunin 1959) and results both from their narrower species concept and from their rather wider interpretation of the Arctic.

The basic chromosome number for each genus is followed by a list of species synonyms. Under the individual species are given synonyms, chromosome number(s), geographical distribution and

a full list of the various chromosome counts. The bibliography includes about 2,300 references and accounts for nearly a sixth of the book. There is an index to genera, including synonyms.

Any taxonomic work by the Löves is guaranteed to raise some eyebrows, and this Atlas is no exception. As they say (p. xviii), they are convinced 'that a correctly and exactly defined species is characterized by a single chromosome number only'. Operating on this basis it is inevitable that they will cross swords with those who regard taxonomy as an essentially pragmatic exercise in which morphological differentiation is still of prime importance. As one would expect, there are taxonomic surprises on nearly every page. Many genera have been split, although many of the unfamiliar names are in fact quite old: *Sedum rosea* goes into *Rhodiola* L., *Potentilla anserina* into *Argentina* Lam., *Rumex acetosella* and *R. acetosa* into *Acetosa* Fourr., *Cerastium cerastoides* into *Dichodon* (Bartl.) Rchb. and *Trichophorum cespitosum* into *Baeothyron* A. Dietr. For the reasons behind these changes and for the validation of their nomenclatural innovations we must consult a paper in *Botaniska Notiser* (Vol. **128**: 497–523 (1975)), which was published after the Atlas.

Some of their changes will meet with general approval. *Luzula frigida* and *Juncus balticus* are treated as subspecies of *L. multiflora* and *J. arcticus* respectively, and *Tripleurospermum* is included in *Matricaria*. However, unsatisfactory as are many grass genera, I for one flinch from the consequences of the massive migration of *Puccinellia* into the diminutive and obscure arctic genus *Phippsia*, of most of *Agropyron* and all *Roegneria* into *Elymus* and the transference of *E. arenarius* into *Leymus* Hochst. Unfamiliar specific epithets abound—*Agrostis capillaris* for *A. tenuis*, *A. vinealis* for *A. canina* subsp. *montana* and *Empetrum eamesii* for *E. hermaphroditum*.

Clearly most of their changes are based on chromosome number. Many botanists regard *Minuartia* as a tiresome split of *Arenaria* (and many of its species as no less tiresome). Not so the Löves. To them it is a cytotaxonomic challenge, without a basic number in sight. The solution is simple. The 11 arctic species are allocated to six genera all with different basic numbers. This involves the creation of two new genera, *Porsildia* and *Lidia*, and the disappearance of *Minuartia*. A similar fate has befallen *Sagina*, *S. intermedia*, *S. cespitosa* and *S. nodosa* having been removed to *Spergella* Rchb. *Gentiana verna* and *G. nivalis* appear in *Calathiana* Delarbe ($x = 7,8$), whilst *Gentianella tenella* is in *Comastoma* (Wettst.) Toyokuni. Species splits predictably include the elevation of the diploid *Asplenium trichomanes* to *A. melanocaulon*, of the diploid *Anthoxanthum odoratum* to *A. nipponicum*, and of the two cytotypes of *Eleocharis palustris* to specific rank. Fortunately they have left certain taxa well alone, such as *Wilhelmsia physodes* ($2n = 50$—110), *Saxifraga cernua* ($2n = 36$—72), and most of the obligate and facultative apomictic grasses. It would be possible to continue in this vein at length; a rough count suggests that at least 20% of the native species in *The flora of Greenland* (Böcher *et al.* 1968) appear under different names in this Atlas.

It is unfortunate that the idiosyncratic taxonomic approach of the authors will inevitably alienate many of the users of what is an extraordinarily thorough and valuable book. Any future Flora of the Arctic will certainly be heavily indebted to it, but its interest and importance are far wider than the title might suggest. Unfortunately it is exorbitantly expensive at DM200, particularly since it appears to have been produced by an off-set litho process.

G. Halliday

British Water Plants. S. Haslam, C. Sinker & P. Wolseley. Reprinted from *Field Studies*, **4**: 243–351 (1975). Obtainable from Field Studies Council, Preston Montford, Montford Bridge, Shrewsbury, Salop. Price £1·20.

Despite the remarkable amateur and professional interest in our native flora and the vast amount of literature on British systematic botany there are very few books entirely devoted to the identification of fresh-water aquatic plants. There has long been a need for an ecological approach to the practical study of plants in the aquatic environment, and this most recent work makes a preliminary fulfilment of this need.

Following a brief introduction on the ecological niches occupied by aquatic vascular plants, on the scope and use of the book, and how to set about collecting and examining water plants, are three principal sections. The first is a key to approximately 120 British vascular aquatics; the second is a systematic account of their distribution and ecology; and the third is a series of 92 line drawings,

showing the natural habit of the majority of the species discussed. There is also a small glossary of terms employed in the key, a scantily written account on the importance, or otherwise, of phytosociological methods for the description of aquatic plant communities, and a useful index.

The dichotomous bracket-key attempts to have as much all-year-round coverage as possible by being based entirely on vegetative characters. It is divided into two main parts. The first is a small 5-couplet key to six artificial groups (A–F) for assemblages of unrelated taxa with similar features such as submerged plants, floating plants, etc. The second part comprises keys to these main groups with a secondary series of generic keys (G–I) for taxonomically difficult groups such as *Ranunculus* subgen. *Batrachium* and *Potamogeton*. These will have great appeal to the beginner and younger users since they are written in simple terms, with admirable thumb-nail illustrations after *each* couplet for correct interpretation of the characters.

The key is well organized and workable. When there are difficulties owing to confusion with cryptograms and younger stages, appropriate notes are given. At times the illustrations come into their own when attempts at simplification lead to ambiguity, e.g. leaves grass-like *v.* leaves strap-like, and leaves *Iris*-like *v.* leaves not *Iris*-like. The policy for omitting hybrids, however, may lead to confusion when identifying some problematic Potamogetons. The second section, in systematic order following *Flora of the British Isles*, 2nd ed. (Clapham, Tutin & Warburg 1962), is a compilation of ecological and geographical data providing useful comparative information about the water type, flow rates, nutrient status, soil types and habitats of the plants. Geographical data are taken from *Atlas of the British flora* and *Flora Europaea*. The last section, to our minds, is undoubtedly one of the most useful parts of the book. Here some 92, mostly half-size line-drawings of habit and vegetative features are presented as complementary to the other two sections. The drawings by Mrs Wolseley are excellent and really convey the information they are intended to give. It is not an easy section to use directly, however, since it is only cross-referenced to the distribution list and not to the dichotomous key.

This present volume, like others in the Field Studies Council series, fulfils an obvious role for the practical understanding of our otherwise overworked flora. The fact that it is modestly priced and aimed at the layman and amateur worker is commendable. The lack of critical content may be wished for by the professional worker, although it is worth purchasing for the illustrations alone.

C. J. Humphries & A. C. Jermy

A Treatise on Limnology, Limnological Botany. G. Evelyn Hutchinson. Pp. x+660 with 164 figures. John Wiley & Sons, New York, London, Sydney and Toronto. 1976. Price £16·75.

The third volume in this series on limnology is a concise and very readable review of the literature on biological and ecological work carried out on both macrophytes and the algal benthos of freshwater ecosystems. The first chapter (Chap. 27 in the series), ambiguously called 'The Lower Rooted Vegetation', discusses Bryophyta and Charophyta; that on the Charophytes is extensive but the Bryophyte papers are less so. Chapter 28 discusses the nature and diversity of aquatic tracheophytes and could perhaps have been fuller in its references to pteridophyte papers on taxonomy which have a modicum of biological observation in them, e.g. the papers on African *Marsilea* by E. Launert. Chapter 29 (130 pp.) discusses the biological characteristics of the tracheophytes of inland waters under such headings as: The change from air to water; heterophylly and environmentally determined variations; photosynthesis and respiratory adaptations; and life history (in which full reference is made to C. D. Sculthorpe's excellent book *The Biology of Vascular Aquatic Plants*).

Under pollination, Hutchinson misses the opportunity of discussing the implications of underwater pollination in relation to recognition-mechanisms between pollen-grain and stigma surfaces seen in terrestrial plants, although, in fairness to the author, the work on this aspect by Pettitt *et al.* (*Micron*, **5**: 377–405 and **7**: 21–32) is too recent for inclusion. Pollination of aquatic plants is in need of study, and simple observations of when and how pollen is released are useful data to record by anyone with the patience to make them. Much of our knowledge in this respect stems from observations made at the end of last century. For instance, is *Zannichellia* apomictic?—there is virtually 100% fertility even when female flowers are covered by mud. *Najas marina* in Britain is

most certainly apomictic, as (to the knowledge of the reviewer) no male flowers have been found here; yet this annual plant produces abundant seed—or did before pollution of the Norfolk Broads occurred.

It is in Chapter 30 (144 pp.) that Professor Hutchinson excels, and here chemical compounds and elements of all kinds are discussed in relation to the environment and the metabolism of water plants in general. This chapter is as lucid and readable as the previous ones, and there is a mass of references and ideas to lead the researcher into useful areas. The penultimate chapter reviews zonations of macrophytes, depth distribution and phytosociology, taking examples from tundra to tropical lakes, and the last chapter describes benthic algal communities from the top of the eulittoral through to the bottom of the euphotic zone. There is an index of lakes, of genera and species of organisms and a general index; and the very comprehensive bibliography contains *c* 740 references.

This volume is a mine of information on aquatic biology; and, whilst many users finding the lucid style both readable and informative will want volumes 1 and 2 as well, it is a book that can be used with only passing reference to the earlier works and well worth owning for its own sake.

A. C. Jermy

Hayley Wood. Its History and Ecology. Oliver Rackham and others. Pp. xv+221, with 26 photographic plates, 33 text figures and end-paper maps. Cambridgeshire and Isle of Ely Naturalists' Trust Ltd, Cambridge. 1975. Obtainable only from the publishers, 1 Brookside, Cambridge. Price £3·00.

Hayley Wood, 122 acres in area, has long been known to Cambridge naturalists as a good example of a wood on chalky Boulder Clay; they used to go there, keepers permitting, to see oxlips. Since 1962 it has been the property of the Cambridgeshire and Isle of Ely Naturalists' Trust, who are to be congratulated on producing this monograph, which is of very much more than local interest.

Like many ancient woods in England, Hayley Wood is of an ill-defined rounded shape and lies on the boundary of its parish; it takes its name from a lost village which, judging from the name, must have originated as a clearing in the forest. Details such as this contribute to the picture of pre-13th-century history. There is more documentary evidence for its later history than exists for most woods, because it belonged to the Bishops of Ely and was involved in a legal dispute between tenants and landlord early in the 17th century. Combining all this evidence with that from neighbouring woods and from field work, Dr Rackham builds up a fascinating and valuable account of the history of the wood, its past treatment, the sizes and destinations of its produce, and its position in the rural economy of the district.

Coppicing ceased in 1922/3, and 40 years of neglect that followed must have impoverished the herbaceous flora; though Dr Rackham says that *Iris pseudacorus* is the best example of a species which has been exterminated by the upgrowth of old coppice, his study of the flora of the disused railway which skirts the wood (see especially pp. 150–152) suggests that some of the species which are now restricted to the railway verges must once have grown in the woodland rides. The period of neglect also allowed fallow deer to establish themselves, thus greatly adding to the Naturalists' problems. There is not only a conflict between deer and vegetation (the deer have already exterminated *Alisma plantago-aquatica* and, having a passion for oxlip inflorescences, threaten to exterminate the oxlips also, and they will destroy any young coppice shoots to which they have access), but also, I suspect (Dr Rackham is very discreet in what he says about this), a conflict between naturalists who want to keep deer and those who don't. In any case it would probably now be impracticable to exterminate the deer, and new coppice coupes, which are essential if the old flora is to be perpetuated, must be securely fenced—we are told the number of man-hours that the work takes, and given other practical hints. All these problems of management are lucidly discussed.

There is a wealth of other good things: excellent chapters on the ecology of the herbaceous communities, of the woody plants—the clones of elm and their spread, the dying oaks, the ages of ash stools (which prove to be the oldest living inhabitants), the ancient hedegerows adjoining the wood, and a specially commendable chapter by M. H. Martin and C. D. Pigott on the soils. All these matters are expounded in a scholarly yet eminently readable way, which would make the

book a good introduction to woodland ecology equally for a university student or for an intelligent lay naturalist.

A common short-coming of the amateur naturalist is that he limits himself to recording the mere *presence* of species; rather less than a quarter of 'Hayley Wood' is taken up by the species lists that result from this kind of observation. The remainder of the book demonstrates how rewarding other kinds of observation, mostly well within the ability of amateur naturalists, can be. I have commented elsewhere (in *Forestry*, **48**: 216–218) on some other aspects of 'Hayley Wood', and have only space to add that I find it a very stimulating book; there must be many naturalists interested in woodland ecology who would derive great pleasure and inspiration from it, even if they have never seen the Cambridgeshire Boulder Clay.

E. W. Jones

Flore de France. Fascicule 2. M. Guinochet & R. de Vilmorin. Pp. 818, with 68 plates. Centre National de la Recherche Scientifique, Paris. 1975. Price Fr 90·00.

However many the objectives of a descriptive Flora, its main purpose is surely to provide the reader with a means of identifying the plants of a delimited area. The question as to how this can best be done depends to a very great extent on the size of the area concerned, and on the total number of taxa involved. With a flora as relatively small as that of the British Isles, it is possible to provide a liberal amount of illustration and text within the compass of a single portable volume. It is also not wholly unreasonable to assume that a reader, defeated by the imperfections of keys and descriptions, may nonetheless reach a satisfactory conclusion by the simple expedient of thumbing through the illustrations until he sees something which answers to the plant before him, a surmise which can be further substantiated by reference to the relevant text.

With a flora as large as that of France, the problems are of an order which rules out such hopeful groping. The reader must submit to the discipline of a system. Moreover if the guide is to be of any service in the field, there must be stringent economies both in text and illustration, and essential identificatory data must be sifted out from the mass of interesting but unnecessary fact.

The present volume, the second of a projected set of four fascicles (the first of which has already been reviewed in this journal) is, insofar as one can judge without actual use in the field, a thoughtfully planned attempt at such a condensation. It consists of short, simple keys to genera and rather more elaborate ones to species and subspecies, the latter often skilfully combining both discriminatory and descriptive characters. With regard to the generic keys, I am pleased to see that the contributors have tried to employ the obvious rather than the erudite. Too often, in their anxiety to attain infallibility, taxonomists ignore the needs of the less informed, and distinguish genera by minute technicalities when other, much more obvious characters would, in the particular circumstances, serve equally well.

The illustrations, though perhaps not as numerous as one might have wished, have evidently been selected with care to elucidate particular difficulties, or to explain unusual terms employed in the accompanying text. They are, like the text, admirably crisp and clear.

Supplementary information relating to habitat, distribution and time of flowering, must of necessity be expressed in such abbreviated form that it is not always very easy to interpret. The habitat data make extensive use of the formal language of phytosociology, a language still very imperfectly understood in this country, and one which we are markedly reluctant to learn. If in fact this nomenclature of plant societies does lend precision to what must otherwise be expressed in very general, vague and unsatisfactory terms, then perhaps it is time we gave it more serious, and more critical, attention.

I am glad to see that Gallic commonsense rules out the use of 'popular' names except where such names are widely and traditionally used; at the same time, it is difficult to see on what logical principle the present selection has been made.

R. D. Meikle

The flora of Lincolnshire. Joan Gibbons. Pp. 351, with 15 black & white photographs and 11 figures. Lincolnshire Natural History Brochure No. 6. Lincolnshire Naturalists' Union, Lincoln. 1975. Price £4·20.

Until the publication of Miss Gibbons' book, Lincolnshire was the only English county without a County Flora of any sort. 1975 therefore marks the end of an era in local Flora writing, and Miss Gibbons is the last of a long line of first-Flora writers that can be traced back to the 17th century.

Like most first Floras, this one shows marked symptoms of condensation, and one is left with the impression that the author has a great deal of detailed information in the files or card indexes for which there was no room in the book. Lincolnshire is, however, the second largest English county, over three times the area of Leicestershire, whose first comprehensive Flora contained proportionally about as much information as that by Miss Gibbons, and whose second contained nearly 1,000 pages of text, much of it in very small type.

Miss Gibbons' introductory chapters, some of which are contributed by other authors, contain much information of value on topography, geology, meteorology, habitat types and botanical history. Inevitably, because of the size of the county, the maps are on a very small scale and the amount of topographical detail is limited. Some critics may regret the absence of a Gazetteer section; for a county as large as this it would inevitably have to be very incomplete, and it was probably wise not to attempt one.

The section dealing with accounts of individual species occupies about 200 of the 350 pages of the book, and appendices concerned with aliens, extinctions, statistics and other related matter occupy a further 20. In this space the amount that can be said about each species is limited; in fact the strictest economy is observed over the quotation of individual records, distribution within the county, and habitat preferences. As regards distribution, Miss Gibbons prefers Woodruffe–Peacock's Botanical Divisions to any kind of grid system, or to recording by parishes. It is worth noting, however, that *The Atlas of the British flora* already provides reasonably up-to-date maps of distribution in the county on a 10-kilometre basis, and to record in Lincolnshire on a 'tetrad' basis would be a monstrous task, requiring getting on for 2,000 tetrads and a total of 500,000 records. It is perhaps a pity that Woodruffe–Peacock chose to divide the county into only 18 divisions, since each of the presence or absence records in this Flora refers to presence or absence in an area almost as large as Middlesex. One senses at once the dilemma which faced the author in deciding how much of the available information to include. Compared with the pages of D. H. Kent's *The Historical Flora of Middlesex*, the pages of this Flora are terribly empty, but to raise the amount of information on each species to the next practicable point on the scale would not only overfill the pages but also increase their number to a significant degree.

It has been suggested that the chapter entitled *The Lincolnshire Naturalists' Union*, consisting largely of a list of LNU Field Meetings from 1893 to 1973, is irrelevant and could well have been omitted, but the seven pages saved would not have provided the additional space needed to enlarge the accounts of species.

My conclusion is that this is an excellent introduction to the study of the Lincolnshire flora, and that it in no way presents a discouragement to further study. Lincolnshire botanists are now left with the fascinating problem of whether to continue working along the lines so ably initiated by Miss Gibbons, perhaps with the parish as the basic recording unit, aiming ultimately at a Flora on the scale of Horwood & Gainsborough's of Leicestershire and Rutland, or to go in for grid recording using a smaller grid than the 10-kilometre one already in use.

K. G. Messenger

Bedfordshire Plant Atlas. J. G. Dony. Pp. 132, with 800 plant distribution maps, 18 other maps and 2 perspex overlays. Borough of Luton Museum & Art Gallery, Luton, Beds. 1976. Price £3·00.

Dr Dony has broken the records for county Flora writing; he has not only produced no less than three, but this *Atlas* is the second by the same author for the same area, and this must be the first such achievement. The new work is in many ways different from the older one (*Flora of Bedfordshire*, 1953). We now have 800 clearly printed maps of plant distributions, with notes on the remainder of the flora, including aliens; and an amount of information similar to that in the *Flora* is now presented much more compactly. The *Atlas* has a short but highly informative introduction, covering survey methods, geology, habitats and recent changes in the flora. Transparent overlays for the maps are included, giving an easy way to compare with factors such as river systems or built-up areas. On the other hand, the original *Flora* was expanded with a botanical history, habitat

surveys, records of non-vascular plants and a bibliography. Those who may wish to compare distributions of species of then as against now will not be able to do so very readily, on account of the very different methods of presentation. In making comparisons we in fact see the impact of Dony's own thinking and its influence on county Flora writing, including the use of the tetrad mapping-unit (a square of 2 × 2 km) pioneered by him. The *Atlas* compares very well for cost with the *Flora* (42s.), even without allowing for inflation.

R. J. Pankhurst

Plant and Animal Habitats in Town and Country. G. E. Simmons. Pp. 96. Blandford Press, Poole, Dorset. 1976. Price not stated.

This book is one of a series with the overall title *Approaches to Environmental Studies*. Many aspects of the environment are studied; for example the weather, roads, railways, villages, churches and religions, police and fire services are but a few of the topics covered in 24 books. These are grouped in four sections, and to each section there is a teacher's guide book as well as programmed texts and ancillary material. This particular book (No. 23) is one of the section that includes topics like pollution and parks and open spaces and is therefore more biological than some of the other sections.

Plant and Animal Habitats is a concise little book defining briefly the meaning of the term 'habitat' and mentioning some of the more frequent plants and animals of habitats like gardens, streets, walls, hedgerows, commons, ponds and waste grounds. It is full of suggestions for observation and the keeping of records which, if carried out successfully, would be most rewarding. To be used really successfully, however, the pupil will require a fair measure of assistance. Thus instructions like 'See how many woodlice you can find' or 'Make recordings of the insects that visit the umbels of Hogweed' are difficult even if identification is carried only as far as the order, for many pupils find difficulty in distinguishing the main groups of insects. However, provided help is available, this is a stimulating little book. It is clearly set out and well illustrated, and there is a short bibliography.

C. T. Prime

Palaeobiology of Angiosperm Origins. N. F. Hughes. Pp. vii + 242, with 73 half-tone and line illustrations. Cambridge University Press, Cambridge. 1976. Price £7·80.

The voluminous literature on primitive flowering plants has been written largely by students of 'recent' angiosperms. An account of them from the point of view of a palaeobotanist is therefore all the more welcome. Alas! The point of view turns out to be a very individual one, and Dr Hughes makes few attempts to build bridges between the territories of palaeontology and neontology. Instead, he points out the dangers of 'back-classification', i.e. of extending the classification of recent organisms to accommodate fossils, and proposes that recent and fossil flowering plants be classified—and even named—in quite separate ways, e.g. by 'development of a separate parallel data-handling code for palaeontology to decrease reliance on the inappropriate International Code of Botanical Nomenclature'.

These generally negative conclusions are disappointing for the neontologist who takes up this book hoping to find concrete data that will either support one of the current theories of angiosperm origin or suggest a new theory. Instead, after providing useful introductory sections on fossils and their interpretation, Dr Hughes examines the relevant evidence from Jurassic and Cretaceous plant fossils only to conclude that 'none of these pre-Cretaceous fossils represents an angiosperm', and that one should 'set aside all theoretical phylogeny until a genuine surplus of Cretaceous fossil information has been accumulated and has been stored under neutral descriptors'. He then occupies a mere 12 pages in examining current theories in the light of the fossil evidence as he sees it; but his conclusions are again depressingly negative. Even theories partly based on fossil evidence, such as the Gonophyll Theory, do not appear to excite his interest.

I am glad to have read this book and would urge anyone interested in angiosperm origins and classification to read it. It will fill in the fossil background to these topics well; but it will also provide a cold douche to dampen evolutionary ardours.

N. K. B. Robson

The Biology and Chemistry of the Cruciferae. Edited by J. G. Vaughan, A. J. MacLeod & B. M. G. Jones. Pp. xvi+355. Academic Press, London, New York and San Francisco. 1976. Price £7·80.

This book presents the papers read at a Conference on the Biology of the Cruciferae arranged jointly by the Linnean Society of London and the Phytochemical Society in London in January 1974.

The addition of the word Chemistry to the book title reflects the predominance there of this aspect of biology; 5 of the 11 main chapters are devoted to chemical aspects—myrosinases (mustard-oil-splitting enzymes), glucosinolates (sulphur-containing compounds giving the Cruciferae their characteristic pungent taste), lipids (mostly fatty acids), seed proteins and volatile flavour compounds.

By a simple process of elimination, one can deduce that the non-chemical aspects of Biology in the present context include taxonomy, anatomy, cytogenetics, crop breeding and population genetics. The survey of systematic and phytogeography by I. C. Hedge makes interesting reading; but, as the author admits, it is still not possible to present a wholly satisfactory classification of this extremely natural family. D. J. Harberd's survey of the cytotaxonomy of *Brassica* and related genera is a valuable summary of the accumulated information on the economically most important group of Crucifers, and it is nicely complemented by P. Crisp's chapter on the breeding of Cruciferous crops, which naturally concentrates on the same group. 'Seed Studies in the Cruciferae' by J. G. Vaughan *et al.* covers both structural and chemical aspects and, contrary to what is often suggested by cytotaxonomists, indicates that *Brassica* and *Sinapis* are indeed separate genera.

The remaining two chapters, on trichomes in *Lesquerella* (R. C. Rollins & E. C. Banerjee) and natural variation in *Arabidopsis thaliana* (M. J. Lawrence), are of a different nature, for the emphasis is on trichomes and natural variation respectively, and it is largely coincidental that members of the Cruciferae are the subject matter.

Although there will be some who regret the use of unjustified photolitho type for a book of this nature, the quality of presentation from both the editorial and publication points of view is high. However, the very unhelpful lack of titles of references, albeit now customary in many works of this sort, is to be much regretted, and in the present case is particularly frustrating because of the large amount of space wasted in the Bibliographies due to the format adopted.

Thus the over-riding impression left by this book is that it contains several very useful chapters, such that a professional taxonomist will want to have it on his shelves, but that, like so many other conference reports, the contents do not hang together very well. This is largely because the organizers of conferences are able to include only those topics for which active research workers are available, and this problem is particularly acute when the conference theme is a single family. The book compares well with the earlier similar survey of the Umbelliferae (1971) and one awaits with interest the report of the conference on the Solanaceae held in 1976.

C. A. Stace

Flowering Tropical Climbers. G. Herklots. Pp. 194, with 260 figures and 16 colour plates. Dawson, Science History Publications, Folkestone. 1976. Price £17·50.

This beautifully printed and boxed book is a delight to possess. I recognized at once all 11 climbers I grew in my garden in Malaya. The 270 line-drawings and 16 full-page colour plates are superb. All have been made by the author during his long life in the tropics. Date and locality are given so we can follow his peregrinations—Hong Kong, Trinidad and Nepal, where he resided, figure frequently. The slightly eclectic text is woven around the pictures; botanical detail (including precise notes on flower colour), habitat and range are included. Dr Herklots has not been well served by his editor and the text is marred by minor inconsistencies in citation and format, and the index, regrettably, is restricted to the scientific names. This should not deter one, for this is supremely an example of elegant book production, sublimely illustrated.

T. C. Whitmore

Reports

ANNUAL GENERAL MEETING, 22nd MAY 1976

The Annual General Meeting of the Society was held in the Jodrell Laboratory, Royal Botanic Gardens, Kew, on Saturday, 22nd May 1976 at 12 noon, with 107 members present.

Mr E. L. Swann (President), in the Chair, opened the meeting by expressing regret at the death in January of Mr J. E. Lousley, who had been a leading member of the Society and one of the foremost amateur British botanists of his time.

The minutes of the last Annual General Meeting, as published in *Watsonia*, **11**: 93–94 (1976), were passed as correct.

REPORT OF COUNCIL

The adoption of the Report for the year 1975, as circulated to members, was proposed by Dr C. P. Petch, seconded by Mr P. J. O. Trist, and carried unanimously.

TREASURER'S REPORT AND ACCOUNTS

The Treasurer pointed out that the Accounts showed the £2,000 deficit predicted by him in his 1974 Report. This was partly compensated for by assets in the form of posters and conference reports as yet unsold but, hopefully, soon to be converted to cash.

Dr I. K. Ferguson commented on the 47% increase in the cost of printing and distribution of *Watsonia*. The Treasurer replied that this included heavy postal increases, and reported that the Editors and the Publications Committee had carried out a thorough investigation of possible economies in the publication costs of the Journals. Implementation of resulting economies should be apparent in the future but present figures were slightly inflated to allow for bills not yet received. The adoption of the Treasurer's Report, together with the Accounts for the year 1975, was then proposed by Mrs B. H. S. Russell, seconded by Mr E. C. Wallace, and carried unanimously.

The Treasurer asked that a vote of thanks to the Honorary Auditors should be recorded, and reported that he had presented them with a Raymond Piper Orchid print from the Society. The President had written thanking the Auditors and their reply expressing goodwill was read. On Dr W. T. Stearn's proposal it was agreed to send to the Honorary Auditors the appreciation of this meeting.

ELECTION OF OFFICERS

The election of Mrs B. H. S. Russell as Vice-President was proposed by Mr E. Milne-Redhead, seconded by Dr J. G. Dony and carried unanimously. The Chairman thanked Mr J. C. Gardiner, retiring Vice-President, for his valuable work for the Society during his long term of office as Treasurer. The following officers were then proposed for re-election: Mrs M. Briggs Honorary General Secretary; Mr M. Walpole Honorary Treasurer; Dr G. Halliday, Dr N. K. B. Robson and Dr C. A. Stace Honorary Editors; Mrs R. Hamilton Honorary Membership Secretary; all proposed by Mrs J. G. Dony, seconded by Miss M. McC. Webster, carried unanimously and thanked from the Chair for the great amount of work achieved for the Society. The election of Mrs J. M. Mullin as Honorary Meetings Secretary, proposed by Mr E. J. Clement, seconded by Dr I. K. Ferguson; and the election of Miss L. Farrell as Honorary Field Secretary, proposed by Dr F. H. Perring, seconded by Mr R. J. Pankhurst, were carried unanimously. Welcoming these new officers, the President warmly thanked Mrs G. Beckett, retiring Field Secretary, who had been successively Programme and Meetings Secretary since 1967. A vote of thanks to Mr D. Langley, acting Meetings Secretary for part of the past year, was also recorded.

ELECTION OF HONORARY MEMBERS

Council had recommended the election of Dr S. M. Walters and Mr E. F. Greenwood. Dr Walters, an active member since 1944 and past President of the Society, had also served on many B.S.B.I.

Committees including the Maps Committee, which had launched the survey for the *Atlas of the British flora* (1962). Mr Greenwood had been an Editor of the Society's Journals for nine years (the Editor of *Proceedings* then an Editor of *Watsonia*) during which time considerable changes in format and of the business arrangements came under his supervision. The President from the Chair proposed election of these two worthy members and this was carried with prolonged applause.

ELECTION OF HONORARY AUDITORS

The election of Messrs Thornton Baker & Co. was carried unanimously.

CHANGES OF RULE

The following alterations to the Rules were passed without dissent:

(a) Rule 9 Election of Vice-Presidents: '. . . to serve a term of four years and not then be eligible for immediate re-election'

(b) Rule 10 Length of service of Council Members: 'A Council Member lost by death or resignation may be replaced for the remainder of the seniority by a co-opted member who shall then be eligible for election'.

(c) Rule 30 Resignation: '. . . written notice to the Hon. General Secretary or the Hon. Treasurer before the last day of December. . . .'

(d) Rule 6 'The Officers of the Society shall be . . . the Honorary Editor or Editors of *Watsonia*'.

ANY OTHER BUSINESS

Mr K. H. Tough, commenting on the content of *Watsonia*, queried the possibility of a wider intake of articles. The Treasurer supported this request. Dr N. K. B. Robson, an Editor, replied that the content of the Journal depended on the subject material offered and that the Editors were willing to publish any relevant article offered if of appropriate quality. Mr E. Milne-Redhead suggested that some members might feel that they would not dare to write a paper attempting to meet the required standard. Mr S. A. Renvoize asked if the Editors could commission papers. The Secretary reminded members that the Editors had repeatedly appealed to members to submit Short Notes for *Watsonia*, and suggested that any members with a note or paper of scientific interest (and of interest to the Society) should offer this to the Hon. Receiving Editor, who would ensure that these would receive sympathetic consideration.

Mr E. J. Clement asked if there was any intention to index *B.S.B.I. News*. The Secretary replied that this had not been considered to date. An index would add to the cost of *B.S.B.I. News* and with the recent stress on cutting costs of publications any decision on this would need careful thought. The Treasurer said that if *B.S.B.I. News* were to be indexed a volunteer for the work would be required. This point would be passed to the Publications Committee for consideration.

The meeting closed at 12.36 and, at the end of the Programme for the day, Dr C. T. Prime, in the Chair, thanked the Director for his welcome and for his permission to hold the meeting at Kew in the very pleasant surroundings of the Jodrell Laboratory. Dr Prime also thanked Dr R. K. Brummitt for organizing local arrangements, and all the speakers, with special thanks to Mr C. Grey-Wilson who had come at short notice with excellent slides of Plants of Nepal.

On the following day, Sunday 23rd May 1976, an excursion was made by 45 members to the Royal Botanic Gardens, Kew, at Wakehurst Place, Sussex, where a guided tour was given by Mr A. D. Schilling, Deputy Curator.

M. BRIGGS

FIELD MEETINGS 1975

ENGLAND

STONE–GREENHITHE, KENT. 27TH JULY

The party of 17 met near Greenhithe Station and, under the leadership of Mr J. R. Palmer, spent some six hours under incredibly hot conditions exploring old lime-pits, the Thames reaches and derelict industrial land.

En route to the first lime-pit near Greenhithe, we saw *Petroselinum crispum* and *Silene italica*

growing in a hedgerow, while the densely wooded slopes surrounding the pit yielded gooseberry, a new tetrad record, and about thirty plants of *Orobanche hederae* in its only current Kent station. The pit was being filled with industrial waste and produced aliens such as *Bromus madritensis*, *Nicotiana alata*, *Artemisia absinthium* and *Lycium barbatum*.

A large number of *Ailanthus altissima* seedlings were found as were also *Lathyrus sylvestris*, *Sorghum halepense*—in at least its second season judging from the impressive root system, and *Hemerocallis fulva*.

A few bird-seed aliens were growing in the pit despite the early season for them—*Setaria viridis*, *Linum usitatissimum* and, of course, *Phalaris canariensis*.

The second phase of the meeting involved a long hot walk starting from Greenhithe Station, where a hedge of *Lonicera japonica* caught the eye, and passing through an Industrial Estate where patches of dried-off *Vicia dasycarpa*, and later *V. bithynica* were pointed out. Along the track of a disused railway were *Lotus tenuis* and *Carex divisa*, while a nearby ditch contained *Berula erecta*.

Lunch was eaten by a small beach near several areas of *Parapholis strigosa*, *P. incurva* and *Agropyron pungens* × *A. repens*. Walking towards Stone marshes, we inspected a good display of *Verbascum phlomoides* × *V. thapsus*. On the edge of the marshes were *Calamagrostis epigejos* and, to the delight of the grass enthusiasts, *Puccinellia pseudodistans* and *P. fasciculata*.

The party then walked over the railway to a vast disused quarry which was about to befilled in with some of London's refuse. We saw, probably for the last time in this pit, *Nardurus maritimus* in the open, while in a woodland area were scores of *Epipactis phyllanthes*, *Listera ovata* and several *Hieracia*. A clearing in the wood was carpeted with *Oenothera parviflora* and, in the deepest part, our leader unerringly located numerous plants of *Pyrola rotundifolia*, all shortly to be buried by rubbish. After a discussion on conservation (the *Pyrola* site was man-made), the day ended with a short tour of Stone churchyard to view *Salvia horminoides* in the turf between the gravestones.

C. G. Hanson

ATTINGHAM PARK, SALOP. 21ST–24TH AUGUST

This meeting gathered in the sad knowledge that it would be the last of a series begun in 1968, for in November 1975 Attingham Park would close as an Adult College and the wonderful hospitality botanists had enjoyed annually would no longer be available. This is particularly frustrating at a time when interest in the flora of Salop continues to grow and the demand for places on a meeting of this kind far outweighs the accommodation.

The aim of the meeting, as in previous years, was to combine instruction in the identification of plants with work on a new Flora of Shropshire. To this end lectures were given each evening, whilst, during the day, visits were made to under-recorded parts of the county where particular 1 km squares were selected for detailed study.

The morning of Friday 22nd was spent in the Hinkshay Field Studies Area, GR 33/69.07, on the edge of Telford New Town, a mixture of pools and woodland, the relics of an early nineteenth-century mining area. This was a good introduction for beginners since there was an abundance of common plants including a number of species pairs needing careful separation, e.g. *Betula pendula* and *B. pubescens*, and *Rumex conglomeratus* and *R. sanguineus*.

During the afternoon we climbed the south slopes of the Wrekin near The Spout. Here a small stream cuts through damp alder/elm woodland which, though much affected by recent forestry, provided a rich flora of woodland ferns and grasses, notably *Blechnum spicant*, *Dryopteris pseudomas*, *Festuca gigantea* and *Milium effusum*, with, occasionally, such herbs as *Lamiastrum galeobdolon* and *Valeriana dioica*.

One of the early decisions of the 'Shropshire Flora Committee' was that for map-making it would be best not to confine our work to the exact boundaries of v.c. 40 (Salop) but draw our limits instead at the edge of 10 km squares. So Saturday morning was spent in the Hereford (v.c. 36) part of 32/4.7 in the woods of Downton Castle Gorge, by kind permission of the owner. Here the River Teme has cut a deep gorge through Silurian rocks and the sides are clothed in mixed deciduous woodland. Many new records were added to the 10 km square including a few specimens of *Tilia platyphyllos*, in full fruit, which could well be native in this locality. *Scrophularia umbrosa* was found in quantity by the river bank; it is a common plant in southern Salop and may well be widespread in v.c. 36 also.

On the way back to Attingham, the whole party descended on the village of Shelderton. Splitting

into about 5 groups we recorded about 170 species in an hour, 16 of which were new to 32/4.7, but this time well inside v.c. 40. Notable finds here included *Agrostis gigantea*, *Pentaglottis sempervirens*, *Cicerbita macrophylla* (a large patch established in the centre of the village), and *Crepis capillaris* var. *glandulosa*, always a puzzle for the uninitiated.

For the last day of this course, and all the Attingham courses, we chose to return once again to the Llanymynech area on the Welsh border where Miss Doris Pugh led us to yet another unexplored corner—this time to Llyn Rhuddwyn (33/23.28), a small lake which lies in a hollow on a ridge at about 1,200 ft. With little water left after the long dry summer, the marshy margins and wooded surrounds were easily accessible and the following local Salop species were found: *Carex vesicaria*, *Littorella uniflora*, *Myosotis secunda* and *Peplis portula*.

Lunch and the final farewells were taken in one of those innumerable Carboniferous limestone quarries which pepper this area. This one at Craig-llwyn (33/23.27) had the usual range of limestone grassland herbs and grasses but was more noteworthy for its aliens than its natives—notably a fine and apparently indestructible patch of *Senecio tanguticus*.

A final roll-call disclosed what a mixed meeting this had been. Out of 20 participants 9 were members of the B.S.B.I., 9 of the British Naturalists' Association and 5 of the W.F.S., yet we had worked happily and harmoniously together without being aware of these differences, which was just as well as some belonged to all three organizations!

F. H. Perring

WALES

WYE VALLEY, GWENT. 7TH JUNE

28 members and friends gathered together at the Wyndcliffe, Gwent from as far apart as Aberystwyth, Yorkshire, Scotland and Wiltshire. Five small areas of limestone woodland were visited as there are no large woodlands left in Gwent that have not been radically changed, since the war, by the Forestry Commission.

The Wyndcliffe, with the panoramic viewpoint known as the 'Eagles' Nest', lies in a Forestry Commission Reserve and it was here that members saw a remnant coppiced wood with ancient yews. *Paris quadrifolia* was not at its best and was half hidden by *Mercurialis perennis*. Near the top of the cliffs, shade had prevented *Rubia peregrina* from flowering. *Arabis hirsuta* was passed, clinging to a precipitous rock face, as the party descended the '365 steps', at the bottom of which *Pyrola minor* was found among the beech leaves. The clearing of an unsafe rock face had prepared new ground for *Atropa bella-donna* and *Euphorbia stricta* to colonize, and *Bromus lepidus* was among the grasses on the roadside verge. *Carex remota* and *C. divulsa* were compared as they grew close to one another on the path to the car-park.

The day was, by now, clear and hot and the cathedral-like clearing at Blackcliff must remain in the memory of those present for a long time. The atmosphere was cool and the light, beech-leaf-filtered green, fell on the fern-covered tumbled rocks, amid which were *Chrysosplenium alternifolium* and *Cardamine impatiens*. Among other plants found were *Epipactis helleborine*, *Cephalanthera longifolia*—the sole survivor of a colony wiped-out under stone dumped from road-widening, *Neottia nidus-avis*, *Convallaria majalis*, *Carex digitata*, and, at its most southern station in Britain, *Melica nutans*.

In Cockshoot Wood a stop was made to see *Dryopteris carthusiana* and the leaves of *Colchicum autumnale* before crossing into Bishops' Barnets Wood, where *Carex pallescens*, *C. pilulifera*, *Melica nutans* and *Aquilegia vulgaris* vied for space.

A brief stop was made in the Coombe Valley to look at *Symphytum* × *uplandicum*.

The final call was at Hardwick Plantation, where the Forestry Commission had set aside, at the request of Gwent Trust for Nature Conservation, a hectare or so for the preservation of some of the 360 plants recorded there and which might disappear if under conifers, like the rest of the wood. The party compared *Platanthera bifolia* and *P. chlorantha* and also saw *Astragalus glycyphyllos*, *Aquilegia vulgaris*, *Trifolium medium*, *Picris hieracioides* and *P. echioides*.

T. G. Evans

SCOTLAND

RIVER TAY, MID AND EAST PERTH. 25TH MAY

This meeting was held jointly with the Andersonian Naturalists of Glasgow and the Perthshire Society of Natural Science, with the purpose of re-examining the flora of river-side shingle beds, previously visited in June 1969 (*Watsonia*, **8**: 189–190).

The party of 21 members and friends left Kinclaven Bridge at mid-day and travelled along the Murthly road to the farm of Kercock. In 1969 the shingle bed below the steading had been dominated by plants of broom and lupin; today, and now in full flower, only the broom was much in evidence. Selective nibbling by an increasing rabbit population was suggested as a possible cause of the lupin's decline. The most noteworthy species in the ground flora were *Aquilegia vulgaris*, *Thalictrum minus*, *Teesdalia nudicaulis*, *Silene maritima*, *Cerastium arvense*, *Geranium pratense*, *Ononis repens*, *Saxifraga granulata*, *Primula veris*, *Veronica filiformis*, *Galium boreale* and *Cirsium heterophyllum*. At the eastern end, in silt overlying the shingle and under alder and willow, several colonies of *Tolmiea menziesii* were in full flower. Continuing westward, we crossed the river by the bridge near Caputh and the farm of Braecock was reached along the private road from the village. Beyond the farm lies The Inch, a shingle bank about half a mile in length, between the river and a backwater. Several of the species already noted at Kercock were seen again here and among those not previously listed were *Lepidium heterophyllum*, *Arabis hirsuta*, *Geranium sylvaticum*, *Origanum vulgare* and *Carex vesicaria*. Cattle now have access to this site, which may account for the decline of the lupin here; there was, however, a flourishing colony of *Lupinus nootkatensis* just across the river. This was reached by re-crossing Caputh Bridge and walking eastward along the wooded bank. In passing it was noted that the alien *Salvia glutinosa*, found here by Mr A. W. Robson in 1959, was still flourishing. Among the lupins, *Trollius europaeus*, *Rubus saxatilis* and *Festuca arundinacea* completed the total of noteworthy plants seen on that fine, sunny day.

R. MACKECHNIE

KIRKCUDBRIGHT. 1ST JUNE

On the day following the Society's Annual General Meeting at Dumfries, 37 members met at Dumfries Station and travelled into Kirkcudbright by chartered bus. The first stop on the road to Dalbeattie was by a steep road-bank near Lochanhead, where Dr Richards started by teaching the uninitiated how to identify various dandelions. *Taraxacum cyanolepis*, *T. euryphyllum*, *T. raunkiaerii* and *T. sellandii* were examined. We also saw a *Pyrola*, identified by those present as *P. minor*. A specimen from this location had been identified as *P. media* by the Royal Botanic Garden, Edinburgh, so further investigation is needed to see if both are present. *Lycopodium clavatum* also occurred on this bank.

The next stop was to examine ferns, by a ravine just east of Kirkcudbright Town. *Phyllitis*, *Polystichum aculeatum*, *Asplenium trichomanes* subsp. *quadrivalens*, *Polypodium vulgare*, *P. interjectum* and the hybrid *P.* × *shivasii* were all present, with a series of hybrids between *Geum rivale* and *G. urbanum*. Dandelions here included *T. unguilobum*, *T. nordstedtii* and *T. croceiflorum*.

The bus then drove around Kirkcudbright Town, so that the Georgian architecture could be admired, and *Erinus alpinus* was noted on the walls of McLellan Castle.

Our main destination was the shore near Borgue, to see an example of the coastal flora. Although *Scilla verna* was just going over, *Astragalus danicus* was in full flower, growing with *Helianthemum nummularium*, *Armeria* and *Anthyllis*, making a very colourful spectacle. In the wetter places *Schoenus nigricans* was abundant with *Eleocharis quinqueflora*, and here *Taraxacum palustre* was noted. The nearest stations of this distinctive and rare dandelion are in Anglesey. The Borgue locality was discovered in 1973 and consists of over 100 plants, making this the largest colony known in the British Isles. Other dandelions included *T. faeroense*, *T. naevosiforme*, *T. norstedtii*, *T. lacistophyllum*, *T. unguilobum* and *T. raunkiaerii*. *Viola canina* was found on the cliffs, the first record for v.c. 73 since 1930.

On the return journey, a stop was made on the merse (salt-marsh) near Southwick. The plant of most interest was a very large colony of *Hierachloe odorata* in full flower. A sedge was found that had the company guessing from *C. diandra* to *C. divisa*, but Mr Jermy decided it must be *C. disticha*, the first suggestion. Dandelions are rarely seen on salt-marshes, but here was a large

colony of *T. spectabile*, with a few individuals of *T. maculigerum*. In nearby woods grew *Polypodium australe* and a well-naturalized group of *Leycesteria formosa*. *T. unguilobum* and *T. sublaciniosum* were here, together with a remarkable dandelion which appears to be undescribed.

O. M. Stewart & A. J. Richards

DUMFRIES. 2ND–6TH JUNE

On 2nd June the group of six and one guest set out to visit a wooded glen opposite Beattock. On the way we stopped at two places to show our visitors what we thought would interest them. Looking over St Ann's Bridge into a deep gorge, we saw a fine show of *Valeriana pyrenaica* at the bottom. Both Beech and Oak ferns were visible.

The next stop was at Lochwood, where there are peculiar old oaks. Spring flowers were still abundant, with *Stellaria nemorum* and *Equisetum sylvaticum* by the roadside.

The Beattock glen had been chosen because herbarium specimens in the Dumfries Burgh Museum suggested that botanical forays used to be made to this beauty spot last century. We were rewarded by making the first post-1930 records of *Cardamine amara*, *Carex laevigata*, *Thelypteris phegopteris*, *Gymnocarpium dryopteris*, *Dryopteris dilatata*, *Lycopodium clavatum*, *Myosotis secunda* and *Circaea intermedia*. *Anemone nemorosa* and *Epilobium brunnescens* were added as first records for the 10 km square.

On Tuesday, 3rd June we visited the eastern side of the county at Carronbridge, Nithside and Wanlockhead. As usual we were marking cards for the 10 km squares. By the riversides the more interesting additions were *Carex hirta*, *Scirpus sylvaticus*—not at that time in flower, *Chrysosplenium alternifolium*, and *Geum* × *intermedium*. The time-consuming run to the old lead-mining town of Wanlockhead left us with less than an hour for botanizing.

Opening the car doors on to *Botrychium lunaria* and *Viola tricolor* raised our hopes, but the finds were few and, with one exception, ordinary. Miss E. Young returned from a look round the churchyard with a specimen of *Draba muralis*. This was the only new v.c. 72 record of the meeting.

On Wednesday, 4th June we visited the part of the Hightae Local Reserve which is on old peat cuttings, where it was exciting to find *Andromeda polifolia*, *Vaccinium oxycoccos* and *Drosera rotundifolia*, enjoying an apparently safe existence in comparison with the other wetlands around Lochmaben.

In the afternoon we went to the disused railway line, now grazed by cattle. Here we saw such characteristic plants as *Chaenorhinum minus*, *Linum catharticum*, *Arenaria serpyllifolia*, *Anthyllis vulneraria* and *Aira caryophyllea*. *Cerastium arvense* has spread on to the line from a dry bank nearby. *Viola canina*, determined by Professor D. H. Valentine, restores a record for the vice-county made in this same square before 1930.

On the last morning a visit to the strand vegetation and salt-marsh at Powfoot was begun in the rain, but we added 11 records for the square, including *Cochlearia anglica*. On the salt-marsh, *Blysmus rufus*, *Eleocharis uniglumis* and *Puccinellia maritima* made up much of the sward. *Ruppia maritima*, determined by Mr J. E. Dandy and looking like green hair, filled a pool.

In the afternoon we ended the meeting by looking at the invasive flora of a dried-up loop of the River Milk at Castlemilk, and adding 9 new records for the square.

It was a worthwhile four days of good companionship enjoyed while adding these records to the squares visited.

J. D. S. & M. E. R. Martin

BALLANTRAE, AYR. 7TH–8TH JUNE

This poorly attended meeting, originally planned for two days, became in the event a one-day meeting, due to the early departure of those participating. However, in the short time available we were able to examine the stretch of cliff and shore between Portandea and Currarie Port lying some five miles south of Ballantrae. The wooded glen near Glendrisaig House was also explored.

The most noteworthy plants observed on the cliffs were *Asplenium marinum*, *Juniperus communis*, *Geranium sanguineum*, *Potentilla anglica*, *Sedum rosea*, *Carlina vulgaris*, *Antennaria dioica* and *Scilla verna*; while in the glen we noted *Polystichum setiferum*, *Equisetum telmateia*, *Hypericum androsaemum*, *Vicia sylvatica*, *Sanicula europaea* and *Allium ursinum*—the last covering the ground over considerable areas to the exclusion of all other vegetation. A brief visit was also paid

to the shingle bank at the mouth of the Stinchar where *Mertensia maritima* was in fine condition, and an after-dinner visit to the coast near Lendalfoot produced *Trifolium striatum*. A total of 200 species was recorded for the 10 km square 25/0.7, of which 12 were additional to those recorded in the *Atlas*.

A. McG. Stirling

KILLIN, MID PERTH. 22ND JUNE

The Andersonian Naturalists of Glasgow and the Perthshire Society of Natural Science (Botanical Section) joined forces with the C.S.S.F. in a very successful 'assault' on the 2,900 ft mountain, which stands sentinel over Loch Tay and Glen Lochay where these two valleys meet. Messrs A. W. Robson and A. M. Stirling led 22 members and friends who met at the Ben Lawers car-park and, by kind permission of the landowners, were able to transport the party to a point *c* 2,200 ft up, almost at the base of the floristically rich cliff-faces. It was a day of brilliant sunshine and so the party concentrated on the arctic-alpine and associated flora of the higher parts. The party agreed to fan out over the whole hill and to assist in compiling a list of species on 10 km cards. Collating this effort produced a total of 166 species. The following rarities provide an idea of the interest this mountain holds and suggest that there are others awaiting discovery: *Potentilla crantzii*, *Dryas octopetala*, *Salix lapponum*, *S. reticulata*, *Armeria maritima*, *Saussurea alpina*, *Juncus alpinoarticulatus*, *Eleocharis quinqueflora*, *Carex capillaris*, *C. saxatilis*, *C. vaginata*, *C. atrata*, viviparous *Poa alpina*, and *Sesleria caerulea*.

A. W. Robson

COWAL, MAIN ARGYLL. 12TH–19TH JULY

The object of this meeting was to look at underworked areas in Cowal. Seven 10 km squares were visited and, although nothing unexpected was found, a good many species were added to the master cards.

12th July: We met at Loch Striven head and went by a forestry road up the glen behind to a fair height. Nothing unusual appeared to be threatened by the forestry operations. The long drought had not helped the flora and the most noticeable feature were the white patches of *Eriophorum vaginatum*. In the afternoon we visited the salt-marshes, disappointing because overgrazed, but we found *Samolus valerandi*, which is fairly uncommon here.

13th July: The party went up the west side of Loch Eck to Bernice on a damp, misty morning which was not helped by the drips from the natural oak woods; fortunately it cleared later. *Lobelia dortmanna* was growing in plenty and we found *Veronica scutellata* growing to about 2½ ft in a bog.

14th July: We met at Achadunan farm in Glen Fyne and drove up to the Lairige hydro-electric dam at about 1,500 ft. It was a beautiful day, interrupted by some heavy thunder showers, and we found some pleasant but not unexpected sub-alpine plants before we went down to Glen Fyne proper, where a surprising number of common species were not on the master-card. A short visit to the house and policies of Ardkinglas House was marred by a thunderous downpour, and it was a damp party which enjoyed a welcome tea provided there by Mrs Noble.

15th July: The party went up Glen Masson and were joined, in pouring rain, by Dr Tayler. It was difficult to see anything and we could not climb the surrounding hills owing to mist. It did not appear a very rewarding area and we finally gave up after lunch. In the evening, however, it cleared and Miss Conacher took some of the party with Mrs Cassels to the salt-flats at the head of the Holy Loch, and added some species, several of garden origin, but *Raphanus maritimus* was interesting.

16th July: The party met at Kinlochruel and drove as far as the road goes past Colintraive up Loch Striven side. It was a beautiful day and the flushes down to the lochside were golden with *Saxifraga aizoides*. There was much *Pinguicula lusitanica* and some *Parnassia palustris* and *Gymnadenia conopsea*. On returning, we visited the policies of ruined 'Southall', very overgrown, and *Polypodium interjectum* and *Listera ovata* were seen. Nearer Colintraive, *Polystichum setiferum* grew on a damp rock, and a walk round Kinlochruel garden added several weeds to the list.

17th July: This was a most beautiful day. We met at the top of the pass into Hell's Glen, where we were joined by Mr McClintock, and climbed Stob an Eas, 2,400 ft, where there was a real alpine flora. *Asplenium viride*, *Cystopteris fragilis*, *Thalictrum alpinum*, *Rubus saxatilis*, *Alchemilla alpina* and *Juncus trifidus* were surviving even the intense drought, and *Salix herbacea* looked very

gay with scarlet, berry-like galls. We came down by the Ardnoe Burn, where there was a spectacular stand of *Bromus ramosus*, to Ardnoe, where we found *Platanthera bifolia*. There had been a dearth of orchids everywhere, probably due to the weather. A short visit to the shore of Loch Fyne ended the day.

18th July: This day was not really in an unworked area as we went to the serpentine outcrop in Glen Daruel to look for *Asplenium cuneifolium*, found by Mr McClintock, and to see the flora, which is unusual for this area. On the way up we saw a really magnificent display of *Asplenium trichomanes* in an old outhouse and a pretty trail of *Mimulus moschata* in a small burn. On the way down there were some of the largest patches of *Lycopodium clavatum* that we had ever seen.

It was generally agreed that it had been an agreeable and rewarding week: though we had not added anything important to the underworked squares, we had found some overlooked plants and the weather had contributed to some very enjoyable days.

R. MONTGOMERY

CRAWFORD, LANARK. 21ST–26TH JULY

Although the number of participants was low and the weather somewhat inclement, many of the 10 km squares in the south of the vice-county were visited and species added to the master cards, this being the main objective of the meeting.

On Tuesday, the first interesting find was *Erinus alpinus* at Culter churchyard, with masses of white *Cymbalaria muralis* nearby on the walls. A roadside verge near Cormiston yielded the hybrid between *Galium mollugo* and *G. verum* – *G.* × *pomeranicum*. *Pimpinella saxifraga* was abundant here on the banks. In the afternoon Corehouse Nature Reserve was visited; *Festuca altissima* was found, but *Poa chaixii* proved elusive. Several *Hieracia* were collected for identification by Mr P. D. Sell.

Snowhill was climbed on Wednesday, the gills providing the greater interest. *Epilobium brunnescens* was abundant and *Sedum villosum* added a splash of colour to the bryophyte flushes. *Gymnocarpium dryopteris* and *Thelypteris limbosperma* were on the screes and *Cochlearia alpina* flowered in a restricted wet patch. A small area of open birch woodland near Earl's Mill yielded ten sedges including *Carex pallescens*; *Helianthemum chamaecistus* and *Cirsium heterophyllum* were found on the roadside verge bordering the wood.

A brief visit to Carnworth Moss was made on the following day, but the more botanically rewarding part were the railway banks nearby.

Friday saw us climbing Tinto, which produced typical *Calluna*-heath with several rich flushes near Greenshiels. *Drosera rotundifolia* and *Narthecium ossifragum* were found at the edge of a fairly rich, upland meadow. *Equisetum sylvaticum* formed a miniature forest on the broad roadside verge.

Although there were few attenders, the time spent was enjoyable and I should particularly like to thank Mrs Allan for her fund of local knowledge.

L. FARRELL

STORNOWAY, OUTER HEBRIDES. 2ND–9TH AUGUST

18 members and guests attended the first official meeting to be held in Lewis since that led by Miss U. K. Duncan in 1959. The aims were to study the grasses, sedges and rushes of the island and to spend two days mapping the flora of under-recorded 10 km squares.

On Sunday, most of the party visited Lews Park, Stornoway, stopping first by a patch of sown grass to see *Festuca pratensis*, also found the previous day by Mr Copping beside the road at Laxdale. On entering the park, a curious *Agrostis*, with short ligules, conspicuous paleas and lemmas long-awned from the base, was gathered and subsequently determined by Dr C. E. Hubbard as *A. canina* subsp. *montana* × *A. tenuis*. An awned form of *Agrostis stolonifera* var. *palustris* was found nearby, and in the woods surrounding Lews Castle grew *Poa nemoralis*, *P. chaixii* and *Deschampsia cespitosa* var. *parviflora*. An interesting discovery in stony ground by the castle was *Festuca rubra* subsp. *megastachys*. The *Deschampsia*, flowering later than the normal form of wet places, was particularly attractive. Miss E. R. T. Conacher and Mr Ribbons recorded the flora generally and found *Trifolium hybridum*, *Epilobium adenocaulon*, *Salix purpurea* × *S. viminalis* and *Petasites fragrans*. *Rubus spectabilis* and *Cotoneaster microphyllus* were noteworthy introduced species happily naturalized.

The next day was spent recording at Morsgail Lodge, Uig, by kind permission of Mr M. Mac-

donald. Mr Slack led most of the party in the ascent of Caultrashal Mór (749 ft), while four members concentrated on the area near the house. The former group discovered about 30 plants of *Hammarbya paludosa*, but in general found the area poor in species. The lower ground yielded *Pinguicula lusitanica*, flowering *Utricularia minor*, *Carex limosa*, *C. pilulifera*, *C. pauciflora* and *Festuca pratensis* again. It was, however, interesting to discover that we had added 12 of the Mapping Scheme's 50 commonest species to a square where none had previously been found.

Tuesday morning was devoted to visiting the Standing Stones at Callanish and the well-preserved broch at Dùn Carloway, and the finding of Miss Conacher's spectacles in uncharted moorland where she had mislaid them a month earlier on a private recording expedition with Miss Campbell. Encouraged by this good fortune we drove to the dunes, short turf and cliffs at Bosta on Great Bernera to see *Catapodium marinum*, and we also found splendid flowering spikes of the rosy-magenta-coloured *Dactylorhiza fuchsii* subsp. *hebridensis*, *Carex hostiana*, *C. arenaria*, *Brachypodium sylvaticum* and *Ammophila arenaria*. A surprising discovery was *Lamium moluccellifolium* on the beach.

Wednesday proved to be botanically one of the most rewarding days of the meeting. We first walked to an area of waste ground near Stornoway harbour to see *Puccinellia capillaris*, previously found there by Mr Copping. This species may well prove to be new to Lewis. On the walk back we passed *Lolium multiflorum* before setting off by car to the salt-marsh at Tong, which yielded *Carex serotina* and *Puccinellia maritima*. We continued to Coll, where Mrs Clark had previously seen *Briza media*, and ate our lunch among *Agropyron junceiforme* × *A. repens*. Then we explored the brackish stream, salt-marsh, pasture and pools to the west of the road. Within an hour we had seen *Potamogeton pectinatus*, *Ruppia maritima*, *Zannichellia palustris*, *Juncus balticus*, *Scirpus tabernaemontani*, *Eleocharis uniglumis*, *Blysmus rufus* and a rich variety of commoner species. The final stop at Tràigh Geiraha, north of North Tolsta, was remarkable for producing *Eleocharis quinqueflora*, *E. multicaulis*, *E. palustris* and *E. uniglumis* round the shores of a single loch, in addition to *Catabrosa aquatica* where fresh water was running over sand to the sea.

Thursday was spent recording near Eishken Lodge by kind permission of Captain and Mrs A. M. Archdale, and Mr D. Kesting of Park Crofters Ltd. Three groups led by Mr Copping, Miss Conacher and Mr Ribbons explored Feirihisval (1,074 ft) and lochans, bogs and sea-cliffs to the east of the house. 192 species were found including *Osmunda regalis*, *Juniperus communis*, *Utricularia neglecta*, *U. intermedia*, *Listera cordata*, *Hammarbya paludosa* and *Eriophorum vaginatum*. *Epilobium adenocaulon* and planted *Alnus incana* were growing near the house.

Friday took us to the Butt of Lewis, with rocky cliff tops dominated by *Armeria maritima* and *Plantago maritima*. However, we recorded *Sagina maritima*, *Puccinellia maritima*, *P. capillaris* (2 plants), and *Catapodium marinum* before moving to Eoropie beach with its sand-dunes and stream. There we were delighted to see *Carex maritima* and *Avena strigosa* growing in the sand. (Later, in Harris, four members of the party were surprised to find *A. strigosa* still being cultivated in the fields). The stream contained masses of *Veronica anagallis-aquatica* and *Catabrosa aquatica*. On our return to Stornoway we passed two fields at Barvas containing *Phalaris arundinacea* apparently being grown as a crop.

The final botanizing of the week was an examination of the plants of the flower-beds outside our headquarters, the Acres Hotel, on Saturday morning. 24 wild species were found, none of which would have enhanced the reputation of the gardener. Suffice it to say that one was *Agrostis gigantea*, providing an addition to our list.

So ended a meeting which had been blessed with fine, sunny weather almost throughout and had resulted in the discovery of 11 out of the 14 rushes, 30 of the 41 sedges, and 43 of the 49 grasses shown in the *Atlas*, and which, in addition, had added *Festuca pratensis*, *Puccinellia capillaris*, *Briza media* and *Agrostis gigantea*.

A. Copping

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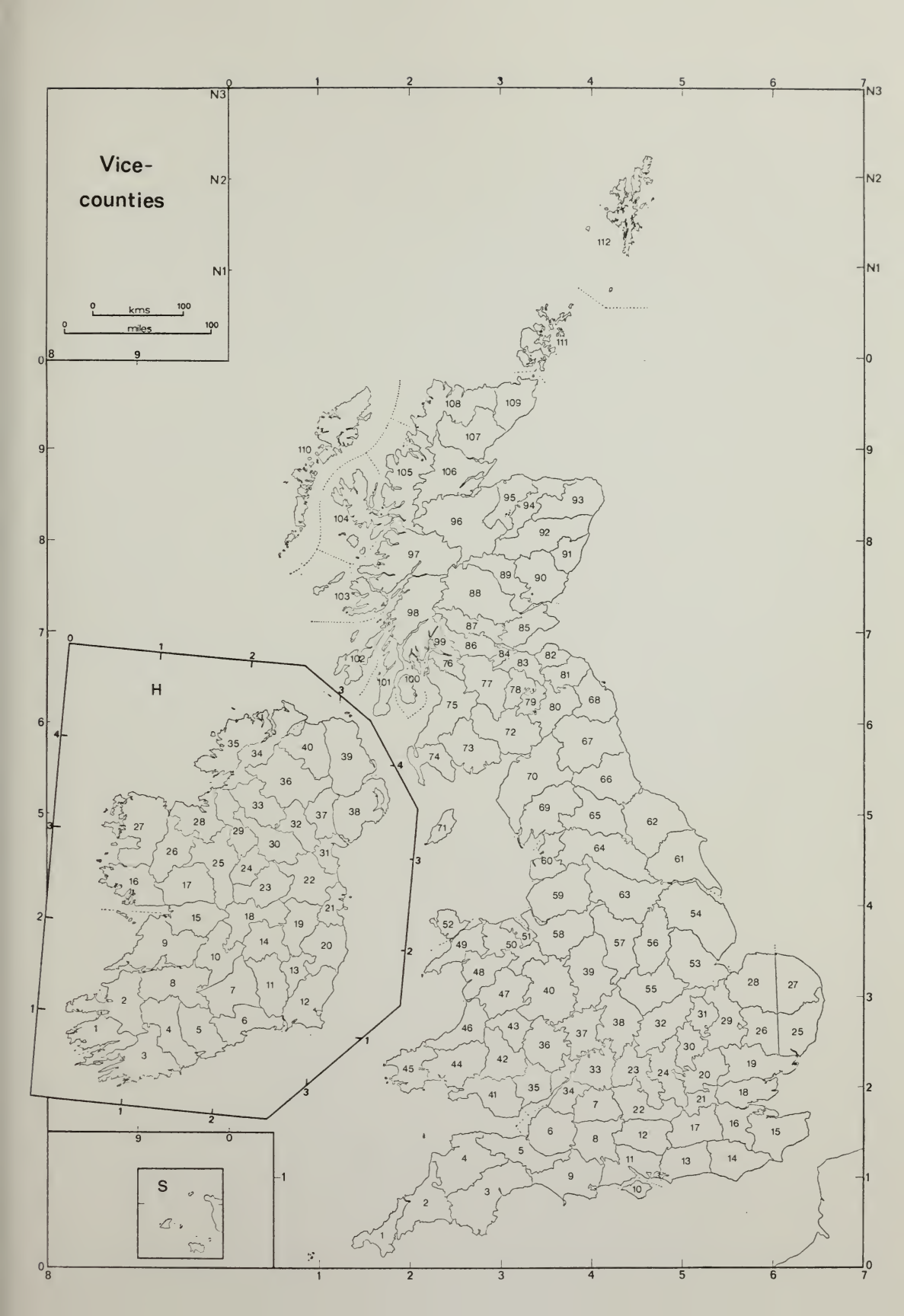
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Published and sold by the Botanical Society of the British Isles, c/o Department of Botany, British Museum (Natural History), London, SW7 5BD

Watsonia, 11 (3). Price Three pounds Fifty pence.

[illegible]

Unclassified Publication